SUPPLEMENT.

The Mining Journal,

RAILWAY AND COMMERCIAL GAZETTE:

FORMING A COMPLETE RECORD OF THE PROCEEDINGS OF ALL PUBLIC COMPANIES.

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Original Correspondence.

THE SCOTCH IRON TRADE—No. II.

THE GARTSHERRIE IRONWORKS.

In furnishing a description of the Gartsherrie Ironworks it will be necessary to premise that the Messrs. Baird, by whom this immense establishment was projected and carried to its present enormous size and importance, were the sons of a respectable farmer in the parish of Monklands. They commenced their career as ironmasters on May 4, 1830, when they put the first furnace in blast at Gartsherrie. From time to time they made additions to the productive power of the parent establishment until it is now the largest in Scotland. But while thus extending the Gartsherrie works they were acquiring other establishments in the West of Scotland that enabled them to meet the increasing demand for Scotch brands. In 1846 they started the Eglinton Ironworks, where there were now eight furnaces. The Blair Ironworks, with five blast furnaces, came into their hands in 1852. Four years later they acquired the Lugar and the Muirkirk Ironworks, comprising malleable ironworks as well as seven blast furnaces. The Portland Ironworks, with five blast furnaces, to which one has since been added, came into their hands in 1864. All these establishments, with the exception of Gartsherrie Works, are in Ayrshire. The total number of blast furnaces owned by the firm is 42, of which 29 are at present in full operation. In some of their speculations the Messrs. Baird have been singularly successful. It is only necessary to mention, as an instance, the Ayrshire Ironworks, at Dalry, which originally cost 70,000*l.*, but which, after the failure with 250,000*l.* liabilities of the company by whom they were projected, fell into the hands of the Gartsherrie firm for the sum of 20,000*l.* Again they were successful, at an early period of their career as ironmasters, in securing a rich mineral field in the neighbourhood of Coatbridge, containing a rich shale or *blaes*, as it is locally styled, which is worked in the mines along with the coal and ironstone. Up till the year 1858 the real value of shale had not been recognised in Scotland. It was thrown aside as worthless until it came to be used for the distillation of paraffin oil. Immense heaps of it were allowed to accumulate in the neighbourhood of coal-pits, just as slag is now accumulated in the vicinity of ironworks. When, however, it was ultimately proved that shale was a valuable mineral product a demand arose for it among oil manufacturers, and the Messrs. Baird have thus been drawing a handsome lordship for the right to work their shale. At the present time the Messrs. Baird are working upwards of 20 pits adjacent to their Gartsherrie Works, including Cartgill, Gartsherrie, Espieside, Kipps, Burnbank, Burny Oral, Palacecraig, Faskine, and Hillhead collieries.

The Gartsherrie Ironworks are situated immediately outside the town of Coatbridge, on the main line of the Caledonial Railway, between Glasgow and Carlisle. There are 16 blast furnaces attached to the works, making them, with perhaps only two exceptions, the largest works of their kind in Great Britain. At any rate, there is no question that the Messrs. Baird are the largest pig-iron producers in the world. They employ altogether upwards of 9000 men and boys, and produce annually about 300,000 tons of pig-iron, or rather less than one-fourth the total make of pig-iron for the whole of Scotland. At the Gartsherrie Works alone 3200 men and boys are employed, and 100,000 tons of pig-iron are turned out every year. The consumption of coal at the Gartsherrie Works is upwards of 1000 tons per diem. The coal pits, as we have already indicated, are mostly within a short distance of the works, so that there is little trouble or expense as regards the supply of fuel. The firm were long enabled to obtain their ironstone from mines in the immediate neighbourhood of their works, but they have been compelled within the last few years to open out fresh mineral fields at a remoter distance, the supply of the blackband ore in the original mines having been well-nigh exhausted. A number of pits are worked at a distance of from 3 to 20 miles from Gartsherrie for the supply, of minerals, as the means of transit are ample and convenient, the firm having the alternative of the railways or the Monkland Canal, the distance of the iron mines is not felt to be much of a drawback. A fleet of 18 steam-barges is maintained for the canal traffic, their capacity averaging 60 tons each. On the railways there are six locomotives, and an almost illimitable number of trucks for carrying on the traffic.

The iron is calcined before being conveyed to the furnaces, the coal arrangements being made at the mines for this purpose. The *modus operandi* may be briefly described. The ore, as it is extracted from its source, is piled on a layer of rough sand, and mixed with a quantity of small coal. The application of fire then results in the separation of the carbonic acid, which is drawn off at a red heat along with the sulphur and other deleterious compounds. After having been thus calcined the ore is at once broken up and removed to the blast furnaces, which stand in two parallel rows on either side of the Monkland Canal. This arrangement of furnaces in relation to the canal is of great advantage; it enables them to obtain a regular supply of coal and ironstone in the easiest and most readily accessible way. The furnaces are various in respect of size and pattern, the later built furnaces having been constructed in harmony with the improvements which the growing access of experience enabled the Messrs. Baird to suggest. No additions have, however, been made to the number of furnaces within recent years, so that the improvements introduced by Mr. William Ferrie and others are still wanting at Gartsherrie. The internal diameter of the hearth of the furnaces is 7½ ft. At the top the diameter is 11 ft., the circumference increasing as the furnace increases in height. There are four arched recesses in the base of the furnace, one being a door for drawing off the slag, while the remaining three are occupied by the tuyeres for the conveyance of blast. The usual charge of furnaces at Gartsherrie is in the following proportions:—Coal, 10 cwts.; roasted ore, 6½ cwts.; red ore, 1½ cwt.; and lime, 2⅛ cwts. With this mixture the iron made at Gartsherrie has become famous all over the world, and it is now quoted at 110s. per ton. The furnace is tapped at six o'clock in the morning, and at the same hour at night the iron is run off, about 60 charges having been thrown into the furnace in the course of the 12 hours. The molten iron is run out into sand-moulds, formed in the usual manner. The slag, after being solidified, is wheeled away to the waste heap, which is believed to be large enough to supply material for a duplicate of the Great Pyramid. To feed each furnace two men are employed. The one fills a charge of coal into a large iron barrow, while the other fills a second barrow with the other materials. By means of a hydraulic lift they are then elevated to the gallery communicating with the mouth of the furnace, from whence they throw the charge into the blazing cauldron below. For generating the blast at the Gartsherrie Ironworks there are three engines, each of them constructed on the beam principle. Together these engines are equal to 300 horse-power, the cylinder of the largest being 5½ ft. diameter. The air-cylinder is 10 ft. diameter. All the other mechanical appliances are on an equally gigantic scale.

Such is briefly an account of the progress and leading features of the largest ironworks in Scotland. It remains to be added, however, that the Messrs. Baird have always taken a deep interest in the social and moral welfare of their workmen, for whom they have provided adequate house, school, and church accommodation.

COAL-CUTTING MACHINERY.

OFFER OF £500 PREMIUM FOR THE BEST MACHINE.

Sir,—I have fully satisfied myself, after several years attention to the subject, that coal *in situ* can be cut most beneficially by mechanical means, under nearly all circumstances of formation. But from the difficulties attending the inspection of the process, and other influences which need not be discussed here, the advantages which would be produced by its adoption have not been realised to any material extent. There have been invented several machines which I believe are capable, and some of them are decidedly good, for the purpose; but owing to the fact that there has not been any actual test of their relative merits the question is in a chronic condition of controversy and doubt. And believing that the adoption of machinery will in numerous ways diminish the risk to life and property, and knowing that the use of machinery materially lightens the duty of the working collier—from whose labour so much wealth and comfort is derived—and in the hope that a more speedy realisation of those advantages may be accomplished, I have decided to offer a premium of 500*l.* to be given for the best machine, as shall be adjudged by a committee of disinterested and properly qualified persons. One of the conditions as respects competition will be that the machine shall be worked by compressed air, and shall be the best adapted for the *various* seams of coal and ironstone.

I have deposited the 500*l.* with the Messrs. W. W. Brown and Co., bankers, Leeds, in the names of three trustees, to await the award of the judges.

I am preparing the necessary preliminary details, which shall be made known as soon as completed. W. Firth.

Burley Wood, near Leeds, March 20.

THE METALLIFEROUS MINES REGULATION BILL.

Sir,—This Bill necessarily differs from the Coal and Iron Mines Regulation Bill. I have been hitherto considering, partly because being the first Act applying to this class of mines, it is in some respects an experiment in legislation; and, secondly, because the evils and dangers against which it is directed, though quite as great as those of coal mines, are of a different nature.

Coal mining is very dangerous because of so-called accidents, often the effects of neglected precautions, but is not unusually injurious to health. Metal miners, on the contrary, are much less liable to injury from accident than coal miners, but suffer far more from disease brought on by their peculiar work. The two chief causes of this excessive disease are breathing bad air and excessive climbing of ladders from great depths. The first kills the greater number, because a very large proportion of miners are exposed to it; the second is most destructive to those who have to climb ladders from great depths, but such are fortunately a small and decreasing minority.

Many will doubtless be disappointed to learn that after the distinct proof obtained by the enquiry of the late Mines Commissioners that excessive mortality of metal miners is produced by bad air and climbing of ladders, it is neither proposed to enact that the air of all mines shall be regularly examined, so that it may be proved to be kept pure, nor is climbing from great depths prohibited; but as it is not possible to preserve absolute purity of air in mines, and not easy to fix the point at which dangerous impurity begins, perhaps, what is proposed is as much as should be at first attempted—to enact that an adequate amount of ventilation shall be constantly produced in every mine, to such an extent that the shafts, winzes, sumps, levels, and working places of such mine, and the travelling roads to and from such working places, shall be in a fit state for working and passing therein. Of course, I cannot dispute that if the air be constantly kept in a fit state nothing more is requisite; but I fear unless something more definite be enacted the fitness of the air to breathe will not always be secured, and, I should like to add, "so that a candle held upright will burn therein," which rule, if obeyed, would prevent men having to breathe air of the worst quality; but that rule alone would be insufficient without securing the regular examination of the air, which is quite as important for their safety as watching the water level of a steam-boiler is for preventing its explosion. If it were directed that the quality of the air in every mine shall be examined, to ascertain the proportion of carbonic acid it contains, which is very easily done with accuracy sufficient for the purpose, and no men allowed to work in air found to be unfit to breathe, the almost certain effect would be that a degree of purity beyond that directed as essential would be secured. A good illustration of this is afforded by the working of the Alkali Act. That Act forbids any alkali maker to allow the escape of more than 5 per cent. of the hydrochloric acid produced; in other words, 19-20ths of the acid produced must be absorbed. The effect of every maker having to take care to absorb nearly all the acid found is, that nearly all of them do absorb almost literally the whole of it, and it is rare for even so much as 1 per cent. of it to be allowed to escape; so if every mine were regularly examined, to see that the proportion of carbonic acid in its air did not exceed (say) 10 times the natural proportion, the almost certain effect would be that it would rarely exceed two or three times that natural proportion. Though 10 times the usual proportion of carbonic acid may be more than is proper, it is much less than is often met with in mines, and a much greater degree of purity of the air would, in practice, be obtained than from regular examination, if that be secured.

It is so easy to estimate the proportion of carbonic acid, not indeed with absolute but with sufficient accuracy, that that need not be any objection. Dr. Angus Smith proposed to the Commissioners, as a convenient mode of testing mine air, filling a small bottle with it, and with ½ oz. of solution of barytes, and shaking the bottle for a short time. If the air contained the stated quantity of carbonic acid the solution will become as turbid as it would if it had absorbed that acid from ten times the quantity of pure air. The exact mode of examining the air need not be enacted, it would be sufficient to direct that the air of every mine shall be examined in such manner as the Secretary of State shall direct, leaving it to be afterwards decided what examination is satisfactory and sufficiently simple, it being exceedingly probable that a still more simple method may be devised.

The most destructive part of a miner's work, to the comparatively small number who are exposed to it, is the exhaustive toil, the disturbance of the respiration and of the circulation, and the excessive overheating by climbing ladders from great depths. I need not go into the proof of this, as it was abundantly established by the evidence obtained by the Mine Commissioners, as was shown in a series of letters published in this Journal by Mr. P. H. Holland, a medical member of that commission. The danger of such excessive exertion is, moreover, self-evident, and the medical witnesses in Cornwall who were examined on this point by the Commission all agreed in attributing a very large part of the excessive disease suffered by Cornish miners to this cause, and the Commissioners unanimously recommended that, in order to avoid the evils consequent on climbing ladders, mechanical means should be provided to convey the men to and from the surface when the mines are of great depth.

It is to me a great disappointment that it is not proposed in the Bill to act upon this very sensible—nay, necessary—recommendation. Of course, I am quite aware of the hardship there must be in enforcing such a rule without exception—that many deep mines are so unproductive that if the erection of a man-engine be insisted on the the mine must be abandoned, and that in many mines—though part is very deep, the greater part of the men work at a moderate distance below the surface. I submit, however, that these difficulties might be met by enacting that such machinery shall be used in every mine in which more than a small number work more than a certain depth below the surface, unless it be shown that the case is a just one for exception. There is, of course, difference of opinion as to what exact amount of climbing can be borne without injury, which will differ according to the health and strength of the individuals who have to climb, but it will by most be allowed that 300 ft., or 100 yards, is a reasonable limit, though some have proposed twice that height, or more than half as high again as the top of St. Paul's, as the maximum to be allowed, or three times the height of the Monument.

It is impossible to lay down any universal rule which would not work hardly in some cases; and, perhaps, the best plan would be to fix a limit as that to be usually observed, and allow the rule to be relaxed upon proof that any particular case is a fair one for temporary exception. The deeper part of a mine may, for example, be for exploration, which could not be afforded if machinery for lifting the men must be provided before the value of the mine is proved. Such a provision as the following could hardly be fairly objected to:—"That no number of miners exceeding twelve be allowed to work in any mine from which they are obliged to climb by ladder through a greater depth than 100 yards, unless an exception be allowed for a period not exceeding one year by special direction of the Secretary of State." It seems by many to be assumed that the man-engine is the only sort of machinery applicable to lifting men in metal mines. This is, however, far from certain. The Commissioners, after examining and enquiring about the cages used in coal mines, the arrangement of which appeared to them both expeditious and safe, thought it might be advantageously introduced in many of the metal mines, and there are very many in which a modification of it could readily be adapted to such mines. Assuming it as possible, though unlikely, that the danger of accidents by machinery would be a little greater than by ladder-climbing, the loss of life would be less, for much fatal disease would be avoided.

The Bill very properly proposes that at every mine at which more than twelve persons are employed underground accommodation for conveniently changing and drying clothes shall be provided. It would be a very useful addition to direct "also for bathing or washing the person all over." After working in a hot, close mine, and especially after climbing, the miners are often in a profuse perspiration, and are apt to catch very severe colds, which prove not unfrequently the commencement of the lung disease, by which the lives of so many are materially shortened. Everyone who has been in a vapour bath knows the importance of tepid bathing before he exposes himself to cold air. Miners on leaving a mine, especially after climbing, are often in as profuse a perspiration as the patients in a vapour bath, and need the protection of a tepid bath as much. At most mines this might be provided for them with great ease, and at little cost, by adapting the condensing water pond for the purpose; and, at all, the advantage of the precaution would be so great that the slight cost it entailed should be, and would be, cheerfully borne. With these alterations the Bill would be a very satisfactory first measure, and, as such, well deserving of the support of the miners and of all interested in their welfare, who desire to check the needless disease which renders so many homes desolate.

Miners, of course, suffer from many evils, the removal of which is not attempted in this Bill, some of which are out of the reach of direct legislation. It must not be supposed that because I do not mention these that I am either ignorant of, or indifferent to, their existence; but those make most progress who do not try to do too much at once. One improvement leads to another, but it is wisest to get one in operation before attempting another. Let us be content with a good beginning—attacking proved evils one by one, until all may be cautiously and gradually abated. Philo.

COAL ON THE KANSAS PACIFIC RAILWAY.

Sir,—It is not generally known that coal of a very fair quality exists on the line of Kansas Pacific Railway. On the Smoky Hill river, two miles south of Wilson's Station, is a cedar bluff, 200 feet high, which is full of coal, though yet undeveloped. This land has, I understand, been reserved by the railway company for the coal. Three miles south-west of the station is a ravine, about 60 ft. deep, which runs up the line between a Government and a railway section, and on each side a 2-ft. vein of coal crops out. That on the Government section was pre-empted and afterwards mined by the Elsworth Coal Company. They contracted to get out a large quantity for the railway company, and did so, but it was carelessly mined,

and left out in the rain, and being a very wet season it was spoiled, and the company refused to take it. This broke up the mining company, but it is the opinion of many that, with the expenditure of a moderate of capital, a very fair quality of coal may be got out. The outcrop, on the opposite side of the ravine has not yet been mined, but is owned by a gentleman in Morgan, who would make very liberal arrangements with capitalists. The estimated cost of laying coal down on the track is 8c. per bushel. There is a large local demand at the neighbouring stations, as well as by the railway company, for good coal at that point.

Cannot some of our mining men on their way West, who if they are posted always give preference to the Kansas Pacific route, in order to see the buffalo herds along the road, make an examination of these coal deposits, and if they are worthy of it, put them before the English market?

Magnesian limestone—or as they term it locally "Junction City marble"—is found in many places along the Kansas Pacific Railway. It is quarried in blocks of from 8 to 10 tons in weight, and even larger, and can be sawn, like wood, to any desirable shape. It is of a delicate cream colour, and when first quarried is quite soft, but soon hardens by exposure to the air. Some of the most costly and elegant edifices in the West have been built of this material. Its durability has been tested for years in the buildings at Fort Riley, and more recently in the capitol building at Topeka, and in other large structures elsewhere. Several towns on the railway are principally built of it, and have a substantial and handsome appearance.

A dark ferruginour sandstone is found west of Junction City. It is a good building material, and when well dressed is equal in appearance to the brown stone, so extensively used in buildings in New York.—*March* 18. M. J. R.

THEORY AND PRACTICE IN THEIR APPLICATION TO MINING.

SIR,—As the *Mining Journal* is always open to the discussion of practical and theoretical questions in their relation to mining, it seems to me that an excellent opportunity to make the lectures of Mr. W. W. Smyth, now in course of publication in its columns, and of delivery at the Royal School of Mines in London, the basis and occasion of improvement to practical men. That gentleman, in addition to his being a graduate at Freiberg, has many and valuable opportunities, arising from the position he occupies as the mineral agent of the British Crown, for improving his theoretical knowledge,—or, in other words, correcting and demonstrating its utility by experimental and natural facts of personal observation. But it may be remarked, however, that whilst his opportunities for observing and his means of information are great—greater than those of almost any other man in England—it is necessarily limited and imperfect, as all knowledge is, embraced by all men; and, therefore, whilst his general knowledge of science in its application to mining may exceed that of almost any other man, there may be, and probably are, views entertained by him and other eminent and talented theorists which are diametrically opposed by facts disclosed in Nature, and appealing both to the sense and the reason of the practical explorers of her hidden mysteries. I have not had time to read through the few lectures which have yet reached me, but from sundry hasty glances at different paragraphs I am led to conclude that on some very important points of practical mining my experience compels me to differ with him entirely.

In your reporter's notes on Lecture VIII. of the series published in the Supplement to the Journal of December 23, the last which has reached me, the all important phenomenon of vein intersections is discussed and illustrated, and rules by which to determine the direction of the displacement of lodes, in what may be termed all cases, laid down. That these rules are specious, and if I were to add pretensious (not on the part of Mr. Smyth I would have it understood, but because I have reason to know that such tenets are held and taught as fundamentals at Freiberg), I certainly could not reasonably be suspected of prejudice in the premises. The rules which the lecturer has laid down for the recovery of a lode which has been displaced by a cross-course, and, in miners' parlance, lost, are—1st. That where two veins, a lode and a cross-course, dip contrariwise—that is, when the dip of the two in descending forms an obtuse angle, or, in other words, exceeds a right angle between their lines of dip—the lode should be sought for along the side of the cross-course towards the lesser angle.—2. When the lode and cross-course dip towards each other, and form less than a right angle between their lines of dip, then the lode should also be sought for on the side of the lesser angle.

Surely it can scarcely be necessary to say here, for the information of miners, that this is but a twofold view of the same thing,—a phenomenon which always occurs at every intersection where a lode and cross-course are not absolutely at right angles to each other. On one side of the cross-course its dip and that or the lode must, from a difference in their strike or bearing, form an obtuse angle, and on the other side an acute angle, because excess on one side presupposes deficiency in the other, the obtuse angle always containing the complement of the acute angle. But, probably, this is not what was intended by "the lines of dip" falling together in depth, and forming less than a right angle, but that the lesser angle intended is to be regarded as accruing on the same side of the cross-course, under it, as before; and that the change in the angle from obtuse to acute in depth is occasioned by a difference in the angle of intersection, by which the *acute* which in the former instance was at the right hand is now found at the left hand. This it will be at once seen is not the result of any change of dip of the respective veins, because no change in this respect, however great it may be assumed or found to be, could ever alter the quality or quantity of an angle by which their divergence is characterised in the plane of their horizon. If it were obtuse on the side towards which the lode dipped, and from which the cross-course dipped, then, whether they dipped either or both, little or much, or none at all, the angle of their intersection extending to depths indefinitely, would be always the same. From this it would appear that the line of displacement of a lode from its intersection by a cross-course is affected by some law relating to the particular angle at which the intersection takes place, and not by any difference in the dip of the respective veins, as, according to the rules now under consideration, it seems to be controlled by some law regulated in its action and marked in its effects by the angle of intersection, notwithstanding the line of displacement may change sides from right to left.

Rule 3, termed a general rule, says if the cross-course is flatter than the lode, determine and lay down horizontally the line of intersection of the two planes, and from that of the cross-cross at the point of its intersection draw a perpendicular line, and on which side of the point of the intersection that line falls, "by being extended backwards." I presume, the lode is supposed to be indicated, and in that direction search for the lodes should be made. Is it necessary to say that this formula is precisely similar in its effects to saying, whenever an intersecting cross-course dips flatter than the lode, always draw along the side of the cross-cross towards the greater angle, if there be one, because the mechanical projection of the plane of the cross-course horizontally will always point in that direction, if I have interpreted the perpendicular line as an index properly? But if I have not, then it will fall with as much regularity on the other side, and indicate as unerringly as the former two rules have done that the lode has to be sought for on the side of the lesser angle. But this I do not think is the case, as I am strongly impressed that my first view and interpretation of the effect of this mechanical contrivance is correct, and, therefore, that the lode under such circumstances, and in obedience to such rule, has always to be sought for on the side of the greater angle.

If such rules were reliable as a guide in this most difficult part of mining, nothing could be more simple in expression, nor more easy of comprehension and application, than they; for, stripped of all unnecessary clothing, the three may be reduced to the following formula:—"When the incline, or dip, of a given lode is less from its perpendicular than that of an intersecting cross-course, and by which the lode is displaced, the missing part should always be sought for along the side of the cross-course, in the direction of the greater angle. But when the dip of the cross-course is less, or when it does not exceed, that of the lode, then the missing or counter should always be sought for along the cross-course, towards the lesser angle."

But, unfortunately, the experience of the practical man does not harmonise with such conclusions. If I have rightly interpreted the rules as given by your reporter, then numerous occurrences within the range of my own knowledge and experience are utterly opposed to them; and some which I might name I have reason to know Mr. Smyth himself has seen, but probably did not notice them in this respect, as I once accompanied him on the occasion of an official visit he made at the request of the Commissioners of Woods and Forests through one of the mines I was manager of in Cornwall, and in which the phenomena of intersections and displacements of lodes by cross-courses were as frequent and as embarrassing as at any other mine in that county or elsewhere.

My apology for thus troubling you on the present occasion is that I do not think that the practical man should allow himself to be restrained by any false delicacy from expressing his opinions on any subject of so much moment to mining, and in regard to which he, and even some of the most eminent theorists, or scientific experimenters, may be found to differ; and also because I believe the time is near, if not already full arrived, when the practical man cannot long maintain his position at the head of mining by being credited with experience merely in the abstract as his passport, credential, and unquestionable qualification for the highly important and responsible office, if he is not prepared to defend his practice against the innovations of theory, and to demonstrate the superiority of its regime to the suggestions of inexperienced theorists, and to do so from induction as a basis, and with respect to economy as an object. In other words, the practical man will have in the not very distant future to vindicate his claims, and justify their preference, against all comers in the arena of mining, and on the ground of utility alone. Not that the practical man will ever be dispensed with, but the danger is that he may be superseded as head of the establishment, and if so by nobodys fault but his own. It is needless to add that such an occurrence would indicate a retrogression which in so vital an industry could not be too sincerely deprecated. ROBT. KNAPP.

Ellsworth, Nye County, Nevada, Feb. 15.

THE SCOTCH IRON TRADE.

SIR,—I notice with some pleasing interest that you have commenced a series of articles on the Scotch Iron Trade, and hope they will not only give a fair representation of the business, but prove useful in many respects. I have been connected with this department since the year 1823—18 years with the Muirkirk Iron Company and 31 years with the Summerlee Iron Company—and for a long period kept a record of all the furnaces in operation. Annexed you have note of those in existence in 1825, which you will find does not tally with the number you give of those in operation in 1830. I apprehend in copying from some source the figures 17 has been made into 7. You have also the estimated yearly make, and the proprietors of the respective works in 1825. M. CRUICKSHANK.

West George-street, Glasgow, March 19.

Scotch Iron Furnaces—Dec., 1825.

	Furnaces.	In blast.	Out.	Yearly make.	Proprietors.
Calder	4	2	2	4,000 tons	Jno. & Wm. Dixon.
Carron	5	4	1	5,0 0	Carron Company.
Clyde	3	2	1	4,5 0	Colin Dunlop.
Devon	3	2	1	3,700	Devon Iron Co.
Muirkirk	3	3	0	5,000	Muirkirk Iron Co.
Omoa	2	1	1	1,500	William Young.
Shotts	2	1	1	2,000	Shotts Iron Co.
Wilsontown	2	2	0	3,5 0	Jno. & Wm. Dixon.
	24	17	7	29,2 0	

Monkland only commenced the following year, 1826.

UNWATERING OF MINES.

SIR,—The complaint of difficulty encountered in the unwatering of mines is so often made in the Journal that it would certainly seem that there is some radical imperfection in the system employed, and it has occurred to me whether it is not the principle of using many separate lifts that is erroneous. The large proportion of the shaft occupied by the pumps necessitates a much larger shaft than would otherwise be required, or, looking at the matter in another light, materially lessens the quantity of air that would otherwise pass into the mine to ventilate it; and I think that if one lift only were used, regardless of the depth of the mine, the economy would be much greater than at present. It is seldom that we hear of a mine more than 300 fms. deep, that is 1800 ft.; but even assuming the ordinary depth to be 2500 ft., which would be over 400 fms., the difficulty of the single-lift system would not be great. Of course a different style of pump would have to be used, and the pump-work would be so different from that now in use that it would be unwise to attempt to make a change in the pumping arrangements of shafts already at work; but for new works it might be worth while to attempt an improvement.

The pressure per square inch of water upon the interior of the pipe which conducts it to the surface would be greater in depth; but as there would be no objection (in fact, rather an advantage) in having the upper pipes of slightly larger bore than the lower ones, it would suffice to calculate for (say) 100 fms. at a time. The kind of pump used should be that known as the submerged pump—a sort of plunger pump inverted; that is to say, the descent of the cylinder over the plunger is made to force up the water. By this means equal area and forcing weight is obtained without loss of material, and all valves, &c., are conveniently packed away in the plunger beyond the reach of injury, consequently nothing but plain tubes are exposed, and if one of these be injured it can be quickly and cheaply replaced. I believe good 4-in. tubes would suffice for any mine, and if the upper end be kept fully open the column of water seems rather inclined to give bodily and overflow at surface, instead of creating any back pressure of dangerovs extent to resist the upward motion of the water at each stroke of the plunger. If one 4-in. tube be insufficient for conveying the water, two, or even three, would be used—a triple tube being, in my opinion, the most desirable—but all would be supplied from one pump.

The only other remark is as to the lifting of the cylinder—the water is raised by the fall of the weight, as in the ordinary plunger; and for this purpose I would use a pair of wire ropes, working over pulleys at surface. These would lie snugly in the spaces between the tubes, and would be unlikely to break both together, and thus lead to the thorough stoppage of the pump. The to and fro motion of the wire-rope would, of course, be obtained with an eccentric, or its equivalent, and if carefully arranged the wear and tear would be scarcely worth consideration. J. K.

PRACTICAL MINING—TIN DRESSING.

SIR,—I did not notice Mr. Sprague's letter in the Supplement to the Journal of March 9 until too late to reply in the next issue; but as remarks are made which indicate a wrong reading of my letter of Feb. 14, I consider it right I should explain. Now, although I concluded by advising Captain Boyns to cease his experiments, and work from a perfected model, I think I was perfectly justified in giving such advice, as I had previously clearly stated that the principle of classification so strongly and rightly urged by Mr. Sprague had already passed the stage of experiment, and had become a practically realised idea, which was then and is now working; therefore, of what possible use can it be for Capt. Boyns, or anyone endeavouring to find out that which is already known, and as I have before stated the principle I have secured by several patents, some of which are the property of the Patent Self-Acting Mineral Dressing Machine Company, of Glasgow. I must repeat that if persons interested in tin-dressing would only take the trouble to visit the Great Darren Mine, they would soon convince themselves that the whole of Mr. Sprague's theory is there reduced to practice; consequently, if Capt. Boyns is experimenting on his theory his labour will certainly be in vain; but should the Captain, after knowing what is already done, fancy he can go a stage further and make something better, then I say, with Mr. Sprague, let him go on with his experiments. And I quite endorse that gentleman's statement when he says that the ore is in the best possible condition for further treatment when it leaves the stamps or crushers (although I do not exactly understand what he means when he says suspended in water, as the rough and heavy stuff is not suspended, yet to some extent mixed with the water, and I think the term mixed would be better than suspended, and in this mixed state is better than by any subsequent mixing after settling) for further treatment. My system acts on this principle: after leaving the crusher or stamps a direct and continuous classification follows. The classification can be effected to any required practical extent—that is to say, the crushed particles are separated at once by a continuous process into as many sizes as the nature of the stuff requires, and by the same continuous process is delivered into the washing apparatus, whether jiggers, buddles, or trunks of any form whatever, where it is either made ready for market, or highly concentrated. The concentrated portion being perfectly classified, leaves but little labour to completely clean it, and without any practical waste.

I may also state that I have recently patented a machine for a more perfect washing of the fine ores, which are now only concentrated; and when I state that no labour whatever is required after leaving the crusher or stamps in the classifying, cleaning, or concentrating, Mr. Sprague will admit that something has been done, and in the right direction, too, as regards his statement, "that after the ores are pulverised in water, a quantity of the richest kind can never be gathered up again." I hesitate not to say that every particle having any practical value will be collected by my system, whether it be carefully or carelessly hand-picked. Hand-picking to a certain extent may be all very well, and is indispensable, yet the use of this machinery will greatly modify and reduce the cost of this department; in fact, the whole dressing can be done at a less cost than that of the present picking and cobbing department. And what shall I say in reference to the saving of ore when you see miles of the Cornish river beds, with their succession of dressing establishments profitably working over and over again what is termed the refuse of the tin mines? Why, Sir, I will not venture to say what the saving in the ore will be, farther than the entire surface cost will certainly be saved. I will conclude by saying that Mr. Sprague's suggestion shall be attended to. If his Cornish friends do not come and look at what I have here, I will certainly make an effort to have the machinery placed at a Cornish tin mine; and if so, the tin men must look at it, and the result I know will be all Mr. Sprague desires.

Aberystwith, March 19. GEORGE GREEN.

BWLCH CONSOLS MINE, AND ITS MANAGEMENT.

To Mr. Thomas Holroyd,—I address you, Sir, as our Chairman of the meeting of shareholders in this mine, held on July 28, 1871, in Mr. William Battye's office, who is acting as our paid secretary, as I should wish to obtain through you what I cannot from him—the particulars of the following sums entered in gross in the last annual statement of accounts ending June 30, 1871:—

Agency	£341	5	0	To whom paid, and in what proportion?
Rent and taxes	182	18	1	Name of land for which the rent is paid, and who derives the profit from this land, which I find is independent of 347l. paid in royalty?
Travelling expenses	7	2	6	Who are the parties who have been travelling at our expense?
London office expenses	172	17	0	How are these expenses made up? Details required.
Mine office expenses	29	5	8	Full details required.
Stationery	7	14	6	
Directors' fees	35	14	0	Who are our directors? Details of their attendance at board meetings required.
Total	£786	17	4	

I consider these as very heavy expenses in a mine that yielded an average of only 24¼ tons of ore per month. It is now absolutely necessary more economy should be exercised, by reducing the above expenses to a minimum; I, therefore, publicly call upon you, as our Chairman, to strike at the root of the evil by reducing the London office expenses by 150l. There will be sufficient margin then left for what is really required to be done in London. Then adopt the same system at this mine as is adopted at the Cwm Erfin and the Bronfloyd Mines, where the yield of ore, profits, and number of men engaged are more than three times that at the Bwich Consols. These are each worked under one captain, which is enough to keep them always at home to attend to the business required of them, instead of which there are three, if not four, captains to do the work of one at this mine, thus allowing one or two of them to accept of engagements, and ramble over the kingdom on a tour of inspection, at the same time drawing their monthly pay from us. This is not fair to the shareholders, whose servants they are: let them do one of two things—either stop at home, and give their whole and undivided attention to the business we have entrusted them with, or stop away, for no man can serve two masters. What do we want with four gentlemen captains, at high salaries, when one is sufficient, to look after a mine which produced during the last six months only 1100l. worth of ore?

As I have thus addressed you through the *Mining Journal*, I hope that you will, or that you will direct our secretary to do so on your behalf, reply in full through the same medium, for the benefit of my brother shareholders.

Pwllheli, March 20. A SHAREHOLDER.

WHEAL VINCENT, ALTERNUN, CORNWALL.

SIR,—Being a constant reader of your valuable Journal I have looked for some time to see some mention concerning the above mine. I am rather surprised, as it has gained great reputation in the neighbourhood. The shares were all readily taken up by mine agents, working miners, and I believe nearly all the rest by local farmers. The mine has been inspected by some of the leading men of the day, and pronounced by them to be the best speculations in Cornwall. There are five known lodes in the sett, all of which have been tested and reported upon. The agent of the mine reported the adit end to be worth 40l. per fathom, and the trial shaft on the same lode to be worth 30l. per fathom, and several other points in the sett have been opened upon and found to be equally as rich. It appears that the old engine-shaft is about 20 fms. deep, and an end driven east and west. It has been stated by some of the men who worked in the mine when it was stopped that the lode in the western end and in the stope above is worth fully 60l. per fathom. The six men who worked in the stope offered to work (when they heard the mine was to be stopped) the above-named stope on tribute for 6s. 8d. in 1l. and pay the cost of the engine. For my part I do not doubt the statement, especially as a brother to one of the six men has bought 65 shares, through his brother's persuasion. And we must remember that tin at the time this mine was worked last was only worth about 40l. per ton. There has not been a mine agent who has inspected the mine but has bought a large number of shares. This I think looks well, as we know there must be something to induce them to purchase. And how many working miners hold shares there I do not know. At any rate, I never saw the working-classes so eager to be in possession of mine shares as they seem to be about those in Wheal Vincent. Capt. J. Main inspected this property I think last week, and he stated that he did not know there was such a sett in Cornwall.

In how many cases do I know where a company has been formed to work on one so-called kindly lode, and thousands of pounds spent, and never saw any mineral, and yet the agent reports that the ground is very congenial for mineral; and in some cases they can find mineralised water coming from the lode, &c. The company tries on, but it ends the same—the lode is still very kindly, but no mineral. It is an old saying, "A bird in the hand is worth two in the bush." And that being the case, it is best to speculate where the mineral is in sight; and such is the case at Wheal Vincent. Anyone paying a visit to the mine will be surprised to see the lumps of tin there, or give a call to the secretary's office, at Callington, Mr. N. Nicholls, and see specimens of its products there. There is any amount of stuff on the mine, and really good stuff, too, waiting for the stamps, which is expected to be in full work some time in June or July. This mine opening up so well, parties are busy about the adjoining setts; in fact, there are three mines gone to work around Wheal Vincent.

I beg to say, in conclusion, that being a working miner, and having worked in and seen a large number of mines, I never saw a mine that I was so much induced to speculate in as I was in Wheal Vincent. A WORKING MINER.

THE TERRAS TIN MINE.

SIR,—I am glad to see my noble craft has sold fully 10 tons of tin; this augurs well for a thumping dividend when June is about over. And glad am I to hear of a fresh discovery in the shape of a new rich lode, supposed to equal Edwards's. The stately barge is now beginning to speak for herself, and that will silence the "bears" more than all my Scotch logic. I tell you honestly it is not every man one can believe in business matters, and while there are some excellent men connected with mining and sharedealing there are some the very reverse, and I know it, and will avoid coming in contact with them. I know a man who bought 50 shares in a mine from a broker, at a cost of 75l., and the man had 3s. a share of profit, and he strongly urged the seller to clear out: this proves my assertion. I hear for certain that a man has sold 500 Terras at 25s. Now, what really business man could do so foolish a thing as that? I advise the shareholders in Terras not to heed what pirates say about the mine; it is too good to suit their purposes.—*Ormiston, March* 19. J. ADDISON.

"CIRCULAR MINING."

SIR,—I am glad to find that at length a prominent member of the Mining Market has stepped forward and attacked the many fictitious "circulars" that are now being so freely distributed. Mr. F. W. Mansell very truthfully designates this system a crying evil and a commercial iniquity. I fully endorse Mr. Mansell's statements, and go further, by stating that this "pernicious system" is incrustating and sapping the otherwise vigorous vitality of mining; and all whose interest it is to promote its healthful development should as fearlessly combat the enemy.

The mining community generally are greatly indebted to Mr. Mansell for the honest, straightforward, and manly course he has adopted.

Liverpool, March 19. A SHAREHOLDER IN MINES.

ST. JOHN DEL REY MINING COMPANY.

SIR,—I fear from the letter of your self "satisfied" correspondent, in the Supplement to last week's Journal, that affairs are even worse with the St. John del Rey Company than I had supposed. A person who, himself writing anonymously, denounces a fellow-shareholder for doing the same, and winds up a letter on a dry business subject with a scriptural quotation, must presumably have a very bad case indeed. Abuse is not argument, and the reasoners who are not to be reasoned against work with different weapons to his. The only notice, therefore, I think it worth while to give to his letter is to retort his own enquiry, and ask him "what man of practical reputation" outside the company's circle does not now hold it a grave mistake to have sunk the A shaft

within only 36 ft. of the old mine. Let him name one such if he can, and, to use his own peculiar language, "until he does that, let him tell his tale to the marines."

Your correspondent, signing himself "Engineer," at least writes like a gentleman, although like one having little "practical" experience of mining. If he will only take the trouble to read the company's late reports more carefully he will, I think, have little difficulty in understanding why I cannot accept his assertion that "the sinking of the shafts does not increase in difficulty at greater depths." If you could spare the space, abundant evidence could be cited from those reports alone to prove that the exact reverse of this is and must be the case. As the 41st report truly states, "hauling the debris and water becomes from the increased depth more tedious," and if more tedious of course more costly. Besides this, the bad soil since come to will, as every practical miner knows, make it necessary to use in future many expensive appliances hitherto dispensed with.

Again, at the present rate of pumping, and no greater power, the February report says is available, the sinking of the shafts is not likely to be resumed this year. The drainage of such a vast volume of water at the maximum rate of 18 in. per day cannot, even if the overstrained pumps hold out, possibly be other than a very slow process.

However unpalatable the truth may be, it is simply idle to shut one's eyes to facts, the suppression of which can be serviceable only to the speculative clique who, without a shadow of reason, last year suddenly ran the shares up 10 or 12 per cent. The staff at the mines when they heard of this rise marvelled, as they well might, what startling discovery to cause it could have been made in England.

ANOTHER SHAREHOLDER.

NEW VAN MINING COMPANY (LIMITED).

SIR,—It may scarcely be necessary to notice the letter in last week's Journal, signed "J. P. Endean;" but I may mention that this company holds the Registrar's Certificate of Incorporation, and no other company has ever been registered under the same name.—8, *Austinfriars, March* 21. E. ASHMEAD, Sec.

ANTIMONY IN NEVADA.

Sir,—In the following communication I have embodied some facts in relation to an interesting occurrence of antimony ores in Nevada. The mines are situated in Humboldt county, 12 miles south of Battle Mountain, a station on the C. P. R. R., 540 miles east of San Francisco, and 360 west of Ogden and Salt Lake City. There are two parallel veins, about 100 feet apart, one of which has been prospected. Both crop out for over a mile, commencing at the top of a ridge, where the Mountain King shaft has been opened, running downward about 1000 feet in a distance of 1500 feet north, where they cross a canon or gully, and thence rise on the opposite ridge, where another shaft, the Columbia, has been sunk to a depth of 93 feet, at a point about 80 feet above the canon. The Mountain King shaft is 15 feet deep, and exhibits from surface to bottom, and in the bottom, a continuous vein, 2 feet thick, of solid sulphuret of antimony. The vein is perpendicular, and has well-defined, regular walls, clearly cutting the country rock.

In the Columbia shaft the vein is not so regular or well-defined, but still contains, in a width of 4 *ft.*, fully 2 feet of solid ore, sometimes in a body, sometimes divided in two or three strings by intervening horses. From the excavation 3750 cubic feet of rock was removed, which furnished 150 tons of clean ore, being at the rate of 1 ton per 25 cubic feet. Of this ore 50 tons have been removed and sold or used, while 100 tons are on the dump.

The ore from the Columbia shaft is an intimate mixture of sulphuret and oxide of antimony, quite free from any other mineral or metal. A careful analysis of a fair average sample of the ore, rough-dressed, resulted as follows:—Moisture, 2·82; alumina (clay), 1·58; silica, 12·62; antimony, 62·28; bismuth, 6·63; sulphur, 15·31; oxygen (calculated), 4·05=99·30.

A specimen from near the surface, at the Columbia shaft, assayed 3 ozs. silver per ton; one from the bottom of the shaft, 20 ozs.; and one from the Mountain King shaft, 19·5 ozs. Mineralogically, the ore consists of—Blue sulphuret of antimony, 56·71; Yellow oxide, 29·09; quartzose gangue, 14·20=100.

These mines are peculiarly interesting on account of the singular purity of the ore, since the absence of lead and copper greatly facilitates the production, by the simplest reduction process, of an excellent quality of regulus of antimony. This was fully proved by an experiment which I made at the works at Battle Mountain Station, smelting the ore in a reverberatory, with native alkali as flux and fine coal as the only reducing agent, and thus producing, in one operation, from crude ore metallic antimony, several tons of which were shipped to New York, and sold to consumers for various purposes. All who have used it pronounce it equal to the imported refined regulus; although some of the pigs were not quite free from sulphur.

The details of the smelting process I do not wish to make public, but that it is inexpensive appears from the following facts:—The furnace, of a capacity to hold only a ton of melted ore, could work this off in 12 hours, producing 800 to 1000 lbs. of metal from 2000 lbs. of ore: 50 per cent. was the best yield I could obtain, and this only when the furnace worked to perfection. The consumption of coal was 1 ton in 24 hours, the fine coal sifted from which was used as the reducing agent, mixed with the melted ore. The loss of metal by volatilisation was quite insignificant, and nearly the whole loss was due to the difficulty of keeping the antimony out of the slag. Several times, from an error in the working or in fluxing, nearly all the metal was scarified, nor could I succeed in reducing it again from the slag, at least in the reverberatory. Mining the ore costs, by contact, *via* Cape Horn, say $15 per ton, meaning always the short ton of 2000 lbs. The ore is worth in England from 12*l.* to 15*l.* per miners' ton, of 2352 lbs., equivalent to about $50 to $62 for 2000 lbs. The regulus is worth from 12 to 14 c. per lb. From these figures it is apparent that a mine of base metal exclusively—for the silver in these antimony ores is too insignificant to be regarded—in the Pacific States may return quite handsome profits, and be more desirable property than mines of silver or gold not strictly first-class.

—*Engineering and Mining Journal* (New York). WM. L. FABER.

[For remainder of Original Correspondence see to-day's Journal.]

EBERHARDT AND AURORA.—The late Chairman of the company, Mr. E. L. J. Ridsdale, F.G.S., chief assayer of Her Majesty's Mint, has, at the request of several large and influential shareholders, drawn up a report upon the property and its management. Mr. Ridsdale examines in detail the process pursued at the International Mill, as well as that at the Stamford Mill, and compares the two, making sundry suggestions for the better extraction of the bullion. Mr. Ridsdale says that the best way to explore Eberhardt will be to tap it in various places, to considerable depths, with the diamond drill, assaying the borings as brought up, so as only to encounter the expense of shaft sinking, or dead work, when the borer affords satisfactory information of a deposit sufficiently rich to warrant the expense. There are at the present time developments in the Ward Beecher which promise well, and there is every probability of the mine keeping up its character, and proving a good investment. The North Aurora is, however, by far the most valuable property that the company owns, and it is without doubt the very best mine on Treasure Hill. Referring to the prospects for the future, Mr. Ridsdale says that the shareholders should fix their attention upon the following points—the assay value of the ore; the output of bullion by amalgamation, and the percentage it bears to the ore milled; the assay of the tailings, and the quantity of tons crushed and milled. In regard to the late management, Mr. Ridsdale concludes by stating that, notwithstanding Prof. Clayton's favourable report of the past management, it is a pleasure to him to believe that all his former old associates, without a single exception, now coincided with his views.

IMPROVED ORE CONCENTRATOR.—The new concentrator designed by Mr. T. WREN, and erected at the Savage Mine, Reese River district, consists of a 12-horse power engine, a Wheeler's crusher of the largest size, a revolving screen, set at a slight angle, open at both ends, the upper and greater part of the screen covered with a No. 60 wire screen or sieve, the lower lesser part with a coarse sieve; and the necessary appurtenances, running gear, &c., for the whole. The process is simple, though entirely scientific. The rock, after being thoroughly dried in the kiln, is fed into the crusher, whence, by means of a spout, it is conducted and fed into the upper end of the revolving screen. The pulp passes through the fine screen, while the waste passes through the coarse screen. The pieces of rock too large to pass through either sieve of the screen are discharged at the lower open end. The rock discharged through the end of the screen is carried by an elevator back to and passed through the crusher and screen. By these means low-grade ores, which have heretofore been worthless on account of the cost of milling, can be worked at a profit. The dump of the Savage Mine is largely mixed with granite or clay, and will average about $25 per ton as it lies. From this comparatively worthless grade of ore 3 tons are reduced to about 1 ton of pulp, assaying fully $60, the residue assaying about $5 per ton. The $60 pulp is then further reduced by water to an amount assaying at the rate of $150.

MINING IN AUSTRALIA.—A letter from Sydney (Jan. 3) says—That which excites most interest at present is gold mining. The gold fever is gradually seizing upon the people. In the towns in the immediate vicinity of the gold fields the balances at the banks are all low, and every shilling is invested in claims. The reports of the miners have fallen upon the ear of the colony like a dream. Gold enterprise has been attended by so many disappointments and blanks as to have fallen out of the list of respectable and safe investments. But a change has come at last. Men do not refer to gold mining as something into which other people may enter, but as that into which they have themselves already entered. Young fellows are getting 300*l.* and 400*l.* a year from 1000*l.* invested in some gold claim. One man I know—the owner of what is called Brown's claim—has got 50,000*l.* worth of gold out of a few square yards of land, and sold his right in them for 25,000*l.* The excitement now prevails on both sides of the Mudgu, at Gulgong and Tambaroora. The whole line of country, from the Green Valley in the north to Chambers' Creek in the south—making a distance of 14 miles, and passing through the Dirt Holes, Tambaroora, Hill-end, and Hawkins' Hills, and crossing the Turen and the Macquarie Rivers, has now been taken up, the claims forming in many places a broad belt of over half a mile in width. Some very fine stone has been obtained in some of these leases: 10 ozs. to the ton is not unusual, and in some places the gold exists in solid plates. The Welcome claim is of a highly auriferous character. I learn, too, that lately a lease of over 30 acres has been taken up on the Old Bald Hill by some of the leading men among the original claimholders of Hill-end. Great things are expected from this speculation. Besides this, the whole of the eastern slopes of Hawkins' Hill have been leased, and will shortly be worked by companies by means of tunnels. Gold is struck at a depth of about 200 feet. At Gulgong the want of water is much felt. The principal lease is being extended in every direction without diminution. The last amount of gold sent thence by escort was 4000 ozs. Gold of great richness has been discovered at Bingera, also at Caloola, near Bathurst. The rise in the price of copper has also stimulated the search for the metal. The 1*l.* shares of the Peak Downs Company are now at 4*l.* 10*s.* Tin ore, of excellent character, is being shipped to England in large quantities. It is found in crystals on the surface over a large tract of country near Armadale, and is picked by hand.

IRON AND STEEL INSTITUTE.

The third annual meeting of members was held at Willis's Rooms, St. James's, on Tuesday, and following days,

Mr. HENRY BESSEMER (President) in the chair.

The CHAIRMAN said that it was with great pleasure he saw so large a number of members around him, for it was not one of those meetings to spend a pleasant afternoon, but one of a purely practical and technical character, to attend which most of them had left business, which would not go on so well, perhaps scarcely at all, in their absence. In coming to the meeting, therefore, they had evinced an interest in the welfare of the trade which was very gratifying. They had hitherto made good progress, for the number of new members admitted had been very considerable, and the interest taken in the Institute was such as promised well for its future success. He would be wasting time if he were to dilate upon the position of the Institute, and would, therefore, at once proceed to the business of the day, by appointing Messrs. Roden and Smith scrutineers to examine and report upon the balloting papers for the election of members. While they were doing this the secretary would read the report of the Council for the year 1871:—

The Council are again able to congratulate the members upon the continued success and usefulness of the Institution. This is shown by the steady increase in the number of members, and by the general interest that has been taken in the proceedings of the society during the past year. At the last annual meeting the number of members was 347; the Institute now numbers 424 members. The voting list for this meeting contains the names of 29 gentlemen who are desirous of becoming members, and since that list was sent out proposal forms of 30 candidates for membership have been received. It will thus be seen that there is every prospect of a regular increase in the number of members.

The provincial meeting of the Institute was held at the end of August, in South Staffordshire. The business meetings were held at Dudley, and excursions were made to the most important ironworks in the district. Arrangements were also made for visiting the principal works in Birmingham and for an excursion to Lilleshall and Coalbrookdale. The members of the iron trade in South Staffordshire and Shropshire gave the Institute a most cordial and hospitable reception, and the Council desire to record their deep sense of their obligations to the gentlemen who made the local arrangements for this meeting.

It having been intimated to the Council that the continental ironmasters felt an interest in the proceedings of the Institute, it was decided in August last to issue a general invitation to the foreign iron trade to attend the present meeting. An official invitation was inserted in several of the leading technical journals published on the Continent and in America; in addition to which Messrs de Laveleye and Son, proprietors of the "Moniteur de Interets Materiel," Brussels, have kindly forwarded a special circular to the principal continental ironmasters. The Council are glad to find that their invitation has been accepted by several gentlemen extensively connected with the foreign iron trade, and in the name of the Institute they desire to welcome these members of the trade, and to bespeak for them a kind and courteous reception when they seek to visit the establishments of any of the members. The same good feeling has on many occasions been shown to individual members of the British iron trade on their visits to the Continent, and the Council are assured that the members of the Institute will rejoice to have an opportunity of receiving officially any representative of the foreign iron trade.

The Puddling Committee that was re-appointed at the last annual meeting have vigorously conducted their enquiries since that time. . . . The Council would recommend that the Puddling Committee be re-appointed, and that the whole matter be left in their hands, to deal with as they may consider most desirable. The attention of the Council has been so fully devoted to the question of mechanical puddling that no further progress has been made in reporting upon the distribution of iron ores in Great Britain. They hope to have something further to communicate on this subject at the next annual meeting of the Institute. . . . The Scotch ironmasters having intimated that they wished the next summer meeting to be held at Glasgow, the Council have accepted this invitation. An influential local committee has been appointed, for the purpose of making the necessary arrangements, and it has been decided to hold the meeting on Tuesday, Aug. 6, and following days.

About 18 months ago the Council were requested to make arrangements for commemorating, in some suitable manner, the valuable services rendered to the Institute by its first President, the Duke of Devonshire. It was ultimately resolved—subject to the approval of the President—that this acknowledgment should take the form of a portrait of the Duke, to be presented to the Institute by the subscribers. This proposal having received the sanction of his Grace, a small committee was appointed to carry out the arrangements. The portrait is now completed, and the subscribers have requested that the presentation should form a part of the proceedings at this meeting. The Council have had much pleasure in acceding to this recommendation. They propose to have the portrait engraved, so that each member may be able to obtain a copy, and by the time the picture is finally in the hands of the Council they hope to have a suitable house in which it may be placed.

In reviewing the history of the Institute, from its establishment in 1869 to the present time, the Council feel assured that the remarkable success which has characterised the movement is sufficient evidence that a technical institution for the iron and steel trades was wanted. They believe that, however satisfactory the progress of the society has been up to this time, there is still ample scope for a development of its operations in many directions. The Council trust that the future of the Institution may be as successful as the past has been, and that each year will furnish it with increasing means of usefulness, and with a wider field over which its influence may be exerted.

The CHAIRMAN, having invited observations on the report, remarked that in the absence of any comment upon it he would propose that it be received and adopted.

Mr. W. MENELAUS seconded the resolution, which was then put to the meeting, and carried unanimously.

Mr. DALE (the treasurer) read his statement of accounts for the year, which showed a debit balance of 152*l.* 3s., to meet which there were certain sums due from authors for reprints, a small amount of arrears of subscription, and a stock of the Journal of the Institute on hand. He remarked that the publishing expenses of the Journal had been exceptionally heavy during the past year, and that altogether he considered their position favourable. The number of members now proposed would create a proper relation between income and expenditure.

Upon the proposition of the CHAIRMAN, seconded by Mr. JENKINS, the treasurer's report was unanimously received and adopted.

Thanks were voted to the President and Council upon the proposition of Lord FREDERICK CAVENDISH, seconded by Mr. RAMSDEN; and to Mr. David Dale, upon the proposition of Mr. I. LOWTHIAN BELL, seconded by Mr. J. T. SMITH.

The retiring members of the Council were unanimously re-elected.

The Duke of DEVONSHIRE proposed, Mr. WALTER WILLIAMS seconded, and it was unanimously resolved—

"That the cordial thanks of the meeting be and are given to Mr. Menelaus as Chairman, and to the other members of the Puddling Committee, for the trouble they have taken in connection with the enquiries they have so ably conducted during the past year, and that they be requested to continue their services during the current year."

Thanks were also voted to Messrs. Jones, Snelus, and Lester for their investigation of the Danks process, and to "many other gentlemen;" and to Messrs. De Laveleye, Son, and Deby, of Brussels, for the trouble they have kindly taken in bringing under the notice of the continental iron trade the invitation of the Council to gentlemen connected with the iron and steel trades of the Continent to attend the present annual meeting of the Institute.

The committee elected to report on the distribution of iron ores was re-appointed.

Mr. I. LOWTHIAN BELL, in an appropriate address, presented to the Institute, in the name and on the behalf of the subscribers to the Devonshire Memorial Fund, a full length portrait of his Grace the Duke of Devonshire, the first President of the Institute.

The CHAIRMAN said that on the present occasion he had the honour of personally representing the Iron and Steel Institute, and in the name of all the members he tendered its best thanks to the subscribers. They had all seen the commencement of other institutions, which had required years for even partial development. This had not been their case; they had had the good fortune to have had associated with them the nobleman on his right hand, and he did not hesitate to say that the Institute had received much of its brightness in consequence of the encouragement it had received from his Grace. He was sure he expressed the views of every member in saying that nothing will have done so much to give them all a favourable recollection of their early connection with the Institute as the portrait now presented to them. He hoped the time was not distant when the portrait would occupy a place in the hall of the Institute, and he had only to tender their best thanks for it.

The Duke of DEVONSHIRE said that they would readily understand that he desired to add a few words to the members of the Institute, but he found himself in difficulty to find words, which difficulty was heightened in no small degree by the terms in which Mr. Bell had presented the portrait. It was highly gratifying to him to receive so marked a compliment, but he could not regard the proceedings of the day as altogether personal to himself. It seemed that the portrait might be regarded as a recollection of the foundation of the Institute, an event which would be properly looked upon as forming a prominent era in the history of the iron trade. It would be a matter of interest to the members to be reminded of the circumstance that in 1869 so useful an association was brought into existence. Before concluding, he must be allowed to express his satisfaction at finding himself associated with gentlemen so nobly assisting to advance the branch of industry with which they are connected. He had seen no trace of jealousy at any of their meetings, no one had permitted self-interest to direct them; but all had been influenced by the desire to add to their common stock of knowledge. As long as that spirit continued to hold a place in their proceedings he was convinced that the Iron and Steel Institute would occupy a prominent position amongst the institutions of the country.

Mr. R. FOTHERGILL, M.P., in proposing a vote of thanks to the Commemoration Committee—Messrs. Dale, Bell, and others—remarked that he had never seen the portrait until within the last few minutes, and must certainly say it was anything but a flattering one. [It was mentioned that the Duke was to give two more sittings.] He was glad to hear it, for at present it was very raw and harsh.

Sir JOHN ALLEYNE seconded the vote of thanks, and it was carried unanimously.

Mr. I. L. BELL said that they were certainly not much entitled to thanks, because they had had no difficulty whatever in obtaining subscriptions—quite the reverse.

The second day's proceedings commenced with the reading of a paper on "The Newport Puddling-Furnace," by Mr. JEREMIAH HEAD, of Middlesborough, in which he remarked that it might seem presumptious on his part to bring forward a paper upon a non-rotating puddling-furnace at the present moment. No iron manufacturer could be more impressed than he in favour of the system which has been investigated by the American commission, and no one would more heartily rejoice at the final and complete success of mechanical puddling. His paper was, however, written before they had any definite information on Danks's process; and it was only from lack of time that it was excluded from being read and considered at the Dudley meeting. The paper contains certain original experiments and investigations hitherto unrecorded, which are as applicable to any form of furnace for heating purposes, and possibly even to that which rotates, as to the old-fashioned appliance, the doom of which seems to be sealed. He then proceeded to explain, by the aid of numerous diagrams, the details of his invention, which appear to aim at utilising every atom of heat, in order to economise the consumption of fuel. He said that many expected to arrive at 10 cwts. of fuel per ton of puddled bar, but that at present was not attainable. They had, however, with the Newport furnace succeeded in reaching an average of 16½ cwts. of coal per ton of puddled bar, whilst 24 cwts. was the usual quantity. Altogether, the result in connection with the consumption of fuel was about 1½ per cent. in favour of the Newport furnace; and it was found that the duration of the grate bars was about one-third greater.

Mr. EDW. WILLIAMS could not help thinking that Mr. Head stood much in the position of justifying the attempt to apply mail coaches after railways had come into operation. After the introduction of the rotary process of puddling they were not likely, he thought, to go on for long in the mail-coach of the old puddling-furnace. There was another point upon which he would like information, that was upon the question of temperature. He had heard gentlemen talk of temperatures of 1100°, 1800°, and 2400° Fahr., but for himself he had failed to measure with accuracy anything above 800°. The different pyrometers did not register the same amount of heat, and the figures obtained with the best of them he believed to be utterly worthless.

Sir JOHN ALLEYNE did not think Mr. Williams's observations quite justifiable. Mr. Head was trying to economise fuel, and he would not like him to go back to Middlesborough with the idea that he is only driving a mail-coach. He thought Mr. Head was following in the same track as Mr. Siemens and others.

Mr. I. L. BELL agreed with Sir John Alleyne that the invention did not propose to deal in a new way with the manufacture of fuel, but to effect a saving of fuel, and if it would avoid loss it would be applicable very generally. He agreed with Mr. Williams that they were accustomed to speak far too glibly on high temperatures. He had himself made many attempts to arrive at something like accuracy, but he found that when they got to high temperatures the instruments themselves disappeared, and they found nothing but a fused mass in their place. The last attempt he made was with an alloy of platinum, and iridium which he exposed in the slag, and he hoped by subsequent reference to the calorimeter to be enabled to obtain the results. He believed that platinum was not fusible at that temperature, and believed so still. But, although platinum is not fusible, the slightest movement of the slag washes away the platinum (which at the high temperature becomes much changed in character) by mechanical action. He was ready to grant his assent to Mr. Head's statements as to the saving of fuel, but he must demur to some of the views he had adopted. He could not assume, for example, that the hydrogen was burnt at the back of the furnace, but, on the contrary, he believed it was burnt immediately on entering. He would remind them that ordinary combustion must not be compared with combustion in the furnace. When the hot-blast was first introduced by Neilson it was presumed that it would be generally applicable, but it was found that no advantage was derived from the use of it in the cupola and other furnaces, and that it was applicable only in the blast-furnace. He did not believe that much good could result from heating the air in the manner suggested.

Mr. HEAD, in replying, said that he agreed with Mr. Williams as to the difficulty of ascertaining high temperatures. He had purchased one of Siemens's electrical pyrometers in its present form, and it was by that instrument that the temperatures were taken. As to Mr. I. L. Bell, he should not presume to enter into a chemical discussion with him, but he would say that he had carefully recorded his observations. With regard to the views he had expressed concerning the decomposition of steam in contact with incandescent carbon he had only adopted the views of the best authorities. In reply to Mr. Plum, he would remark that although the invention had not yet been applied in connection with balling-furnaces he was quite satisfied that it could be so applied.

The subjoined report of the Puddling Committee was then submitted:—

REPORT OF THE PUDDLING COMMITTEE.

In the report presented to the last annual meeting, the Puddling Committee stated that they recommended the appointment of two gentlemen for the purpose of visiting the various ironworks in Great Britain, where improved arrangements for puddling had been introduced. Immediately upon their re-election the committee proceeded to carry out this arrangement. They engaged the services of Capt. Bodmer, civil engineer, to report on the mechanical features of any apparatus that had been designed for the purpose of improving the puddling process, and through the kindness of Messrs. Hopkins, Gilkes, & Co., of the Tees Side Ironworks, Middlesborough, they were able to secure the services of Mr. R. Lester, to report upon the practical part of the enquiry. These gentlemen have spent about 80 days in carrying out the investigation entrusted to them. It is not necessary to enter into minute details of their proceedings, as their reports upon all the more important improvements that have been tried in this country of late years have recently been published in the pages of the Journal of the Institute. The arrival of Mr. Danks in this country, and his statements to the effect that his machine was then in successful operation in America, tended to make the enquiry of the English commissioners of less value. They investigated the merits of the rotary puddling apparatus as far as they could be made out, from the materials at their disposal; and it is only fair to those gentlemen to state that from the first they spoke most favourably of Mr. Danks's system. They took steps for verifying the accuracy of such statements as admitted of being tested by experiments, and they were afterwards more fully confirmed as the correctness of their views. It was felt that the statements of Mr. Danks ought to form the subject of an early communication to the general body of members, and arrangements were accordingly made by which the merits of the new apparatus might be described and investigated at the meeting of members, to be held in Dudley in the succeeding August. The English commissioners, therefore, handed over this report to the puddling commissioners. They then proceeded to complete their enquiry. They were in several instances called upon to report upon processes and arrangements which at the time of their visit were in an early and experimental stage, but which have been subsequently amended to a considerable extent. They have not included some improved plans, because special papers on these subjects will be submitted to the present meeting. Altogether, the English commissioners collected for the committee particulars of nearly everything of importance that has been done during the last few years, with the view of improving the puddling process. This information is now in the possession of the committee, and it is quite possible that it may eventually be of much value, both in a practical and historical sense.

When the Puddling Committee met at Dudley, and considered the statements contained in Mr. Danks's paper, they felt that many of these were so much opposed to the general experience of British ironmasters, that it would be advisable to appoint a qualified commission for the purpose of making a thorough investigation of the operation of Danks's puddling machine in America. They suggested this course to the general meeting at Dudley, and their recommendations being approved, they proceeded to carry out this arrangement as speedily as possible. They requested the Dowlais Iron Company to allow Mr. Snelus to report on the scientific facts, and the company very liberally and cordially acceded to the wishes of the committee. They prevailed upon Mr. J. A. Jones, of the Ayrton Rolling Mills, Middlesborough, to act on the commission, as they

sit that his extensive practical acquaintance with the iron manufacture would be of great service in an investigation of this kind, and though at much inconvenience to himself he consented to serve on the commission. In consideration of the fact that the communication of Mr. Danks had been made at the South Staffordshire meeting, the committee asked the trade in that district to nominate a third member of the commission, and Mr. Lester, of Wolverhampton, a thoroughly competent, practical man, was accordingly appointed. The Committee held several meetings to arrange the details of the enquiry. They provided 40 tons of pig-iron and a quantity of fettling material available in this country; and early in October the commissioners left Liverpool for America, accompanied by Mr. Danks. The committee drew up detailed instructions for the guidance of the commissioners, and these have been rigidly and minutely acted on. No small difficulty had to be encountered in conveying such a large quantity of heavy material 900 miles into the interior of the States; but everything reached its destination safely; the commissioners were allowed the fullest operations of carrying out their experiments at the Cincinnati Ironworks, they also visited every other place in America where Danks's apparatus was then at work, and about the middle of December they sent off from Washington their general report. The committee having considered this document, and knowing that the members felt a deep interest in the American enquiry, decided to publish the report immediately, and the details are, therefore, well known. They have, however, requested each commissioner to communicate to this meeting a supplementary report, dealing with various matters that it was impracticable to introduce in the joint report. The committee desire to express their great satisfaction at the manner in which the commissioners conducted this enquiry, and they consider that the best thanks of the iron trade generally are due to them for their valuable services.

Previous to the commissioners leaving England the committee agreed with Mr. Danks that the royalty to be paid for the use of his apparatus should not exceed 2s. per ton.

The committee finding themselves pledged to an expensive enquiry which was likely to be of great pecuniary advantage to the trade, and feeling that it would be unfair to burden the resources of such a young institution with the cost of this investigation, they decided to make a general appeal to the iron manufacturers of the country for special funds with which to defray the expenses of the enquiries upon mechanical puddling. This appeal was very liberally responded to, but as the total cost will turn out to be much greater than it was originally anticipated, the funds already subscribed will not be sufficient to meet the total outlay.

The committee learn with much satisfaction that the English commissioners were received in a most courteous and hospitable manner throughout the States, and they desire to record their obligations to the American iron trade for the facilities they afforded the commission for pursuing their investigations; and also to a number of gentlemen who in various ways contributed to promote the success of the investigation.

Whilst the commission was in America, Messrs. Hopkins, Gilkes, and Co., of Middlesborough, proceeded with the erection of a revolving puddling-furnace, on Mr. Danks's system. This was completed about the middle of February, and as the firm invited the Puddling Committee to see it in operation, a meeting was held at Middlesborough at the end of last month. The experimental furnace was found to do its work in a highly satisfactory manner, and fully confirmed the statements that had been made by the commissioners. It was not possible to do very much, except to inspect the working of the machine and its adjuncts, and to test the quality of the finished iron produced. In all these respects the experimental workings were eminently successful, and the members of the commission present were satisfied that the machine is capable of puddling iron, and producing better results than can be obtained by the ordinary method of hand-puddling.

The committee also visited the West Hartlepool Ironworks, in order to see Mr. Spencer's machine in operation. They saw two heats of about 10 cwts. each puddled, in a comparatively short time; the iron produced was of good quality, and worked well under the hammer, and in the subsequent processes. In the last heat the iron was brought out in two large and well-shaped balls. The machine of Mr. Spencer has been described in the reports of Messrs. Bodmer and Lester, but as it appears to have undergone several important improvements subsequent to that description, the committee requested Mr. Spencer to make a short communication to their meeting, upon his furnace, as it is now in operation.

Messrs. Howson and Thomas also showed the committee a revolving puddling-machine, recently invented by them, and which has been put up for experimental purposes, at the Newport ironworks, Middlesborough. The committee saw two heats worked in this apparatus, and though many of the arrangements are incomplete, the iron was puddled successfully; but as the apparatus is not attached to a forge, the quality of the material produced could not be examined. The committee have also requested the patentees of this furnace to make a communication on this subject to the Institute at the present meeting, and doubtless full details of the machine will shortly be laid before the members.

The committee do not feel called upon to record their opinions as to the relative merits of the various machines for puddling iron that have come under their notice. They have endeavoured to collect as much information about each as was possible, and this they have communicated, or have arranged to communicate, to the members, who will thus be in a position to make their own deductions from the information now available. Of this, however, there can be no doubt—the feasibility of mechanical puddling is at length demonstrated beyond doubt. This in itself is a great fact, and one which the iron trade have been anxiously awaiting for many years. Whether the new method is to be much or any cheaper than the system at present adopted time and experience will prove; but it must be a great satisfaction to the members, as it is to the committee, to know that there is at length a prospect of the laborious and exhaustive work of hand-puddling being superseded by a mode of procedure of a more rational and scientific character.

Mr. MENELAUS, in proposing the reception and adoption of the report, remarked that it promised that hereafter they would get rid of hand-puddling. The committee had not given a very decided opinion, as they had not had the opportunity of examining Danks's furnace in comparison with Spencer's furnace, and those of other inventors. Having, as all were well aware, himself paid considerable attention to the question of mechanical puddling, he accepted the report of the American Commissioners, and considered puddling in rotary vessels now an established fact. He heartily congratulated Mr. Danks on his great success; his improvements were clever and ingenious, and did him much credit. All that Mr. Danks had said at Dudley had been fully verified by the investigations of the American Commissioners, which was more than could be said with regard to the descriptions which most inventors gave of their own inventions. He was also of opinion that Mr. Spencer's machine was very ingenious, but he thought he was complicating the difficulty by dividing the heat and attempting to get it out in three balls. He believed even 10-cwt. balls might be worked with suitable machinery, and he believed inventors' difficulties would not be so great in inventing machinery for dealing with heavy balls as to divide the heat in the vessel. He would recommend Mr. Spencer to accept the difficulty of dealing with a large mass of iron instead of dividing the heat. He had given the subject his attention for 20 years, but he now hoped that before long they would get rid of mechanical puddling altogether.

Mr. I. L. BELL seconded the reception and adoption of the report. He remarked that Mr. Menelaus had modestly omitted all mention of the prominent part he himself had taken in connection with mechanical puddling. He had told them that he had failed, but no one would persuade him that it was not mainly by the fact that Mr. Menelaus had considered the subject worthy of his attention that the mind of the public had been directed to the matter.

Sir J. ALLEYNE had seen two machines at work—Danks's (as put up by Messrs. Hopkins, Gilkes, and Co.) and Mr. Spencer's. In his opinion Mr. Spencer need not separate his balls, and although he considered it an advantage to give the machine a to and fro motion, as well as the motion of rotation, this second motion was not necessarily part of his system. If Mr. Spencer hung his machine centrally, his balls would occupy the same position as Mr. Danks's. He believed Danks's moveable flue to be a great advantage, but he would advise the meeting to carefully look at the merits of all the inventions before adopting either.

Mr. HOPKINS said that the best evidence he could give of their confidence in Danks's invention was that they were proceeding at once to erect more machines on Danks's principle, and he hoped in six months to have a complete puddling forge at work on that system. The rail exhibited on the table was rolled direct from the bloom, and stood five times the test of an iron rail. It would not break with the falling blow, and, as they all knew, it was very difficult to get iron to stand that test at all.

The report of the Puddling Committee was put to the meeting, and unanimously adopted.

[To be continued in next week's Mining Journal.]

DANKS'S PUDDLING FURNACE.

At the American Institute of Mining Engineers, New York, on Feb. 16, Mr. SAMUEL DANKS explained his new puddling-furnace, which substitutes steam for manual power. He had conceived the idea in 1856, and in 1857 was nearly ready to start, when the financial crash stopped his operations. He has recently carried the plan into successful operation. The iron is placed in a hollow cylinder, hung and revolving upon an axis at right angles to its central line, so that the melted metal is thrown from end to end at each half revolution. By this process 5 tons can be as readily puddled at once by steam-power as 500 lbs. could formerly by hand. The result is shown at Chattanooga to be the removal of impurities more perfectly than ordinary puddling. The phosphorus is entirely removed by the new process. The iron may be heated to a higher temperature than it can be worked at in hand puddling. The furnace is lined with the oxide of iron, and, instead of losing 15 to 20 per cent. by the process, it is found that there is actually a gain of 7 to 10 per cent. Ordinarily we can make 2 to 2½ tons before re-lining.

Dr. VAN DER WEYDE: I was not aware until to-night that the oxide of iron was used for the lining. That is a most beautiful method, for the oxide of iron is itself partly reduced, and there is a gain instead of a loss in the charge.

Mr. FISHER: How large a mass of iron can you make to roll into a boiler-plate, for example?

Mr. DANKS: There is scarcely a limit to the size of the puddled ball. It depends upon the apparatus for reducing the lump. The iron is more perfectly puddled than it possibly can be by man power.

Dr. VAN DER WEYDE: I suppose it is as homogeneous as Bessemer steel.

Mr. DANKS: A puddled ball is alway homogeneous and crystalline. The fibre is due to the elongation of the crystals, by rolling and hammering. If you wish to retain a portion of the carbon you can stop the puddling process at any stage you choose, and then you will have steel, and that will remain steel, without showing fibre, through a great number of workings. Or we can make the finest quality of iron. We can make an iron that will bear a tensile strain of 70,000 lbs., when the same material treated in the ordinary furnace will not bear more than 50,000 lbs., for the simple reason that the puddling is more complete. In the old hand process, the iron was liable to have faults, and it was necessary, therefore, to weld several bars together to make it homogeneous. In this that is unnecessary.

The PRESIDENT: What is the cost of the puddling, as compared with the hand process?

Mr. DANKS: It is about one-half, depending upon the quantity produced. It takes about the same number of men to man the furnace, but the labour is less. It will bring another class of men into the puddling field, for I have not found many of the old puddlers of any use. I have found that a good man from the machine shop would make a better puddler than the old puddlers, for the reason that the latter will stick to the old ideas.

Mr. STETSON: In making balls of 700 or 800 lbs. weight, how much does the whole revolving mass weigh, charge and all?

Mr. DANKS: The cylinder is about 6 feet in diameter outside and 4½ ft. long. The whole weighs about 5 tons. We have a pair of engines for each furnace. Several velocities are necessary, and also a reverse. The axis rests upon four rollers, so that the friction is not very great. When we are refining, a slow motion is necessary.

THE PRESIDENT: Have you built any in England?

Mr. DANKS: The iron and steel manufacturers sent a commission, who brought about 60 tons of material, and have tested the process, and have made a favourable report.—*Engineering and Mining Journal* (New York).

COMPRESSED AIR-ENGINES,

AS USED FOR HAULING AND PUMPING UNDERGROUND AT THE THORNHILL COLLIERIES.

An able and exhaustive paper "On Compressed Air-Engines for Underground Purposes in Collieries" was read at the recent meeting of the Midland Institute of Mining Engineers, held at Wakefield. It was the joint production of Mr. W. P. MADDISON, of the Thornhill Collieries, near Dewsbury, and Mr. J. FARRAR, engineer, of Barnsley, and a patentee of coal-cutting machinery, who has made several air-compressing machines for the Thornhill, Holmes, and Carr House Collieries, Messrs. Fox and Co., Deepcar, &c. The paper opened by noticing the convenience of compressed air in the working of coal mines, because, whatever length the pipes may be conducted, there was no loss from condensation, nor was there the same tendency to faulty joints as in steam-pipes. As to its being beneficial to the ventilation of a colliery, the tendency was in that direction, owing to the excessive coolness of the air when given off from the engine. At the North Gawber Colliery compressed air was successfully applied some three or four years ago, and at Thornhill, where it became desirable to work certain coal lying at a considerable distance from available shafts, very much below the water-level line of the pumping-engine, it was determined to adopt it. Mr. Farrar (Pigott and Farrar, Old Foundry, Barnsley) was applied to, and he supplied a single air-compressing engine (21-in. steam-cylinder and 20-in. air-cylinder) to be placed on the surface, a double cylinder-engine with four drums for hauling purposes, and a double-action pump for getting the water out of the dip workings. The compressed air to be conveyed through pipes 4½ in. in diameter as far as the hauling engine, a distance of about 470 yards, thence through 3-in. diameter pipes 1300 yards to the pumping-engine, and having two receivers, one 15 ft. by 4 ft., and the other 8 ft. by 2 ft. placed at intervals. Those were duly erected and worked well. The pressure on the steam-boilers being 40 lbs. air pressure of 35 lbs, or 36 lbs., was obtained. The engine could haul 42 sets of 16 tubs at a distance of 600 yards for a day's work, and could have apparently run the same number of much heavier trains in the same time. To accomplish that, however, it was found that the surface engine had to run at a speed much too great, and that the wear and tear on the valves, &c., in connection with the air-cylinder was so excessive that it could not be upheld with the assured certainty and safety necessary. To rectify that another air-cylinder was attached to the other end of the crank-shaft. The result being rather worse than otherwise, the engine was made double throughout, by adding another steam-cylinder as well as a second air-cylinder, the two engines working at quarter-stroke. The change fully realised all that was desired, as by 40 lbs. of steam-pressure 70 lbs. of air-pressure was obtained, thus exactly doubling the power previously got by one air and one steam-cylinder. Air-power appeared to be almost unlimited in application, provided the air was conducted through sufficiently large pipes, so as to diminish the friction, or by means of a number of receivers for distributing the air throughout the length of the pipes, or by adopting both means.

As to the formation of ice at the exhaust, the best and easiest method for meeting it was found to be by making the outlets large. In one instance the difficulty was overcome by constantly burning a gas jet under each cylinder. The air-compressing engine at Thornhill was placed at bank close to the boilers. The steam cylinder worked with a maximum pressure of 40 lbs. per square inch. The engine consisted of two steam cylinders 21 in. in diameter 3-ft. stroke, each having an area of 346·36 square inches; the cubical contents of one stroke for both cylinders being 49,875·84 inches; and two air-compressing cylinders, 20 in. diameter, 3-ft. stroke, each having an area of 314·16 square inches, the cubical contents of one stroke for both cylinders being 45,239·04 inches. The cranks are placed at right-angles, and the engines could be worked together or separately. The underground hauling engine was placed in the main road, 334 yards from the drawing-shaft, and consisted of two cylinders 10 in. in diameter and 18-in. stroke, each having an area of 78·54 square inches, the cubical contents of one stroke for both cylinders being 5654·88 inches, with four main and tail ropes, drums 4 ft. in diameter. In the second motion the revolutions of the pinion-wheel to the spur-wheel on the drum-shaft are as 2·88 to 1. The drums were put in and out of gear by sliding carriages. The length of plane hauled over was 550 yards, and was worked by means of head and tail ropes, the head rope drawing a set of 20 tubs, each being 3½ cwts., and carrying about 6 cwts. of coals, or an aggregate of 9¼ tons; the tail rope drawing in the empty set. There was another hauling-engine placed over the main road, 880 yards from the drawing shaft, consisting of two cylinders, 9 in. in diameter and 12-in stroke; and there are two others in other parts of the workings, one of them being placed at the top of the incline, 1326 yards from the drawing shaft. It consisted of a pair of cylinders, 7 in. in diameter and 12-in. stroke. The length of line hauled over was 352 yards, the empty set of tubs being sufficient to overhaul the rope. The pumping underground engine was placed 1634 yards from the bottom of the shaft, and consisted of one cylinder 8 in. in diameter 18-in. stroke, working a 6-in. diameter double-action pump, 18-in. stroke, the capacity of the pump being 3·67 gallons for each stroke. When the engine was making 60 revolutions per minute there was registered a pressure of 59 lbs. per square inch, the water passing through two holding-up valves. The experiments with the engine gave the following results:—

Air pressure at No. 1 compressing engine	59 lbs.
Ditto, No. 5 pumping-engine, when all standing	60½ ,,
Ditto, ditto whilst working	58 ,,

The underground pressure stood 1½ lb. higher than at the compressing engine, thus recording a higher pressure underground of 1½ lb. than on the surface, the difference of level between the two points of observation being 444 ft. The height at which the water was delivered was 82 ft. 10 in.; when the engine was running 31½ strokes per minute, 115·61 gallons were delivered; the water-pressure on the guage being, whilst standing, 36·5, and whilst running 44, friction being denoted by 7·5. On the engine running 60 strokes, 220·2 gallons were delivered per minute; the water-pressure on guage being, whilst standing, 36·5, whilst running, 65, friction, 28·5. An air-receiver, 15 ft. by 4 ft. diameter, was fixed at the bank, close to the air-compressing engine-house, with safety-valve 5 in. in diameter. The compressed air was conveyed into the workings through metal pipes 4½ in. in diameter in 9-ft. lengths. The length of the pipes in use was 5330 feet.

Much stress had been laid on the assumption that in the introduction of compressed air there would necessarily be a large percentage of loss from leakage at the joints, &c., in the pipes. But from the experience at Thornhill such was found not to be the case, for although the pipes had been put down at that place there had not been a single leaking joint throughout the whole length of the pipes—some 3300 yards, with 600 joints. With regard to temperature several valuable and interesting experiments were made. It was found in one instance that although the air pressure never in the slightest degree varied from 45 lbs. to the square inch, and the speed of the engine slightly increased from beginning to end, yet *steam* was gradually being diminished by the man in charge. At 11·20 the heat registered at the cylinder appeared to have reached its maximum, but from 11·24 it again gradually began to ascend until it reached its maximum (256°) at 12·32, and from that time the speed of the engine increased more rapidly than in the earlier portion of the experiment. It was also found that whilst the heat generated through the cylinder stood at 256°, the heat registered in the receiver close alongside the engine only reached 97½°, and the same density or elastic force existed in the pit at No. 2 engine at a temperature of 44°. When they lost the heat they did not lose the power, and yet it was said that by the creation of heat they must exert power of tremendous magnitude, which was a dead loss, and ought to be made available. As Mr. Van der Weyde states—"Heat is now believed to be merely an atomic oscillation. It comes under the ordinary law of dynamics, and the motion of atoms may be transformed into the motion of masses, a transformation of which in the steam-engine we have the most conspicuous example." The experiment to which allusion has been made fully bears out the words quoted, for the heat evolved is in strict accordance with the intensity of atomic oscillation, and disappears as that atomic oscillation ceases to exist. The question as to the cost of haulage by compressed air would be found to vary according to circumstances—viz., the size of the tub, the thickness of the coal, the gradient, description of rail, &c. At Thornhill, where the seams worked are thin, the following estimate of the relative cost by air and horse power has been made, and is in itself highly interesting:—

WORKING BY AIR-POWER.

Consumption of rope, 2700 yards, calculated to run on an average three years, say 12 cwt. per year, at 34s.				£20 0 0
Maintenance of way, pulleys, tubs, &c.				52 17 0
Oil and tallow for engines				14 0 0
Cost consumed by one boiler, 280 days, at 3 tons 12 cwts. = 1500 tons, at 1s. 6d.				75 12 0
General repairs, estimated at				23 0 0
Labour: 4 lads attending engines	£0	6	4	
1 firer (proportion)	0	2	0	
1 man repairing roads	0	3	6	
10 lads attending drums, &c.	0	12	4	
280 days at	£1	4	2	= 338 2 0
				£526 3 0

50 runs per day of 6 tons each = 300 tons per day, or 84,000 tons per annum.

Runs 24 × 23 chains = 552 chains.
,, 26 × 62 ,, = 1612 ,,
50 50)2164(average 43 chains or 946 yards.

Cost of haulage on total quantity passed along the roads by compressed air, average distance 946 yards = 1·503d.; cost of haulage per ton per mile = 2·786. Without putting the machinery or labour to the slightest strain, it would be quite possible to run at least one-fourth more work, thereby increasing the weight of coal to 105,000 tons, and reducing the average cost to 1·2027d. and 2·2376d. per ton respectively.

HAULAGE BY HORSE-POWER.

If the same amount of work had to be done by horse-power, 26 runs of 6 tons = 156 tons from the dip. One horse estimated to haul 6 tons per day would require 26 horses and 26 lads (say) at 3s. £3 18 0
24 runs of 6 tons = 144 tons (horse estimated to haul 18 tons per day) would require 8 horses and 8 lads at 3s. 1 4 0
1 man attending roads 0 3 6
£5 5 6 = 1477 0 0
Maintenance of way, tubs, &c. 47 14 0
£1521 14 0

Cost of haulage on total passed along the roads by horse-power, an average distance of 946 yards, per ton, 4·356d.; cost of haulage per ton per mile, 8·101d.

The difference in the cost of the two modes cannot fail to be duly weighed by colliery proprietors in all parts of the kingdom.

A cordial vote of thanks was unanimously passed to Messrs. Maddison and Farrar for their valuable and elaborate paper.

Royal School of Mines, Jermyn Street.

[FROM NOTES BY OUR OWN REPORTER]

LECTURE XXVII.—When we pass (continued Mr. SMYTH) from mere stempels or stull-pieces put into strong ground to places where the levels require more extensive support, we have to deal with a variety of contrivances, all, however, based upon the grand principle of placing the greatest power of resistance opposite to the heaviest pressure. Thus, when the pressure is lateral or transverse a sort of framework is put in, called in Cornwall a durnz, in Germany a thürstock, or doorway, and in France a cadre. These are formed with two uprights, with a timber across at the top called a cap-piece, and sometimes with one at the bottom called a sole-piece. The fitting of these properly together is a matter of great importance. [Mr. Smyth exhibited some models of this kind of timbering, as used in the Hartz.] In these the leg pieces were made to slope outwards at the bottom, and strengthened by struts passing across the corners from the upper part of the leg to the cap-piece. The closeness with which these durnzes are placed together will depend upon the nature of the ground. In the Hartz they are frequently in sets about 3 feet asunder, but if they come upon a piece of ground stronger than usual the sets may be put further off, or, in the opposite case, nearer each other. In fitting them together many clever plans are in use in various districts or countries, but the great aim of all is to make as few cuts as possible in the timbers, which would certainly tend to weaken them. If the weight be great from above particular care must be taken to make the joints in such a manner that the pressure will rather hold them together than weaken them. The Cornish cap (illustrated by diagram) is a good example of ingenuity in this respect. In some collieries and iron mines in the North of England, where round timber is used, the top of the upright is simply hollowed to receive the end of the cross-piece, but when this is done care should be taken so that the hollow is not cut too small. If it be, the pressure will soon split the upright down the middle, and I have been in mines where this work has been done so carelessly that the uprights have been split one after another for some distance along the level. In a like manner care must be taken that the whole strength of the cap-piece is available, and has its proper effect. When the pressure comes from the sides a good deal of ingenuity is requisite to put in transverse props so as to keep the leg-pieces asunder. In Cornwall, as most of the timber has to be imported, it is used almost invariably in a square state, and the plans in use there are admirably adapted to maintain the stability of the cap-pieces. The difficulties of securing levels are greatly enhanced if the ground is soft, as the uprights must then have timber placed for them to rest or stand upon.

In copper mines and large lodes this frequently occurs, and it is then necessary to put in transverse pieces, and sometimes to rest the former on longitudinal sole pieces. In these cases the cost of timbering soon becomes excessively high, and the continual necessity for repairs great. If the frames are obliged to be close together more wood will be required and more expense incurred than if they were wider apart. It will thus be seen that the placing of timber in levels requires skilled workmen appointed for the purpose—men capable of putting in the supports required both systematically and symetrically. They are called timbermen, and ought to be persons not only experienced, but ready at expedients, and capable of understanding the nature of each individual case of pressure they have to meet. For instance, besides the direct pressure, of which I have spoken, downwards and sideways, they have frequently to encounter an oblique thrust, and may have to use curved timber, and so to set it that the radii of the curves may be placed in the best position to resist the weight. Another very important action of the ground requires continually watching. There is sometimes a tendency to push down the frames, in which case cross shoots must be put in. They may not need to be very heavy or strong, as a very slight stay will mostly prevent the frames from being pushed out of their proper position. Under certain circumstances, and in large lodes, the timber is often very large. Thus in the case of the Isle of Man, where the timber is some of the finest for the purpose ever seen, there are immense cap-pieces no less than 13 in. square, and leg pieces 7 in. square. The pressure there to be encountered is so tremendous that I remember seeing some which, after being in only three years, the timber, although perfectly sound, had its fibres so twisted and broken that the 13 in. were reduced to 9 in., so far as power went, and the cap-pieces had to be replaced by fresh timber. Indeed, where there is much movement in the ground timber has frequently to be replaced every six months.

And where the ventilation is inefficient, and great dryness and heat, dry-rot makes great progress, and rapidly destroys timber, greatly increasing the difficulties of preserving the openings intact. In the case of a level to be kept open where they have a floor of a permanent character a plan is adopted in some of the German mines of bringing the upper ends of the leg-pieces together, and so supporting the centre of a strong cap-piece. In large lodes, where the breadth is often very great, the timbering required is often of very large dimensions. At the Botallack Mine, for instance, which is carried 160 fms. below the sea level, it is necessary to keep open the thoroughfares to the deeper portion of

the mines by immense stempels, supported by struts; but perhaps the most remarkable timbering in Europe is that to be seen at the Devon Great Consols, where timbers from 20 to 35 feet in length, and of proportionate thickness, are used. At the St. John del Rey Mine, in the Brazils, the walls are supported by innumerable timbers of large size, some of the struts being built, as it were, of several pieces. At the Wheal Anna Maria, in the Devon Great Consols Mines, there is a remarkably strong piece of timbering of unusual shape. There is no cap-piece, and the side pieces of red pine, which are 18 ft. long by 15 in. square, come together at the top, forming with its sole piece a triangle. It is lined with planks, and the space between the side-pieces and the ground is carefully filled with attle, so as to equalise the pressure. The structure is further strengthened by struts across the upper part of the triangle. This plan was adopted to economise the enormous quantity of timber which even with that saving is required to keep open this roadway.

The question next to be considered is that of securing the levels where the ground is of a loose character—a very different matter from simply excavating the rock, and putting in timber, with the best effect. Suppose in a great lode, such as I have been speaking of, the timber gives way, and the level has to be opened again through a loose material (say) of decomposed granite, or "running ground," as the miners call it—or, if in driving they meet with quicksand, or very soft and watery material which will not stand up, but comes down with a run, the greatest caution is required. This is a sort of thing which often happens in particular districts, and some very remarkable instances have been recorded in the Transactions of the Northern Institute of Mining Engineers. They also occur frequently in Belgium and in the Northern coal fields of France, where these soft materials go down to a considerable depth, and have to be crossed by the workings. Now and then they occur in the tin veins of Cornwall, although the general character of the country is strong granite or clay-slate. For instance, in that part of the country known as the china-clay district the workmen have great difficulty in keeping the levels horizontal and regular, although when close timbered it is difficult to detect the reason of the deflection. The fact is that the miners would probably swerve from the direct line, in order to get out of the difficulty; and a glance at the maps of most of the mines will show levels which have swerved from the direct line again and again from causes of this kind. Indeed, it is not unfrequently thought better to try a fresh start, and to give up the old level. When, however, none of these devices can be employed, what is called "spilling" comes into play.

It will be well, however, by boring to ascertain the extent of the loose material to be passed through. In really dangerous ground bore-holes in front and on the flanks ought to be kept in advance, so that the miners may have timely notice of their approach to a place where, but for spilling, advance would be impossible. Spilling is a work which requires a good deal of presence of mind, alertness, and dexterity on the part of the men. Starting from the last place, where there is firm ground the workmen put in a frame as close to the forebreast of the opening as possible, and then drive into the ground above, over the cross-piece of the frame, what are called spilling-boards or laths. These are 6 feet or 8 feet in length, with the end sharpened and shaped into a sort of trapezoidal point, which will give it a tendency to rise with a deviation of from 18° to 20° from the horizontal direction, the weight above soon bringing them down to almost a straight line. These are driven in one by one close to each other, and when the whole breadth of the excavation is thus protected the men remove the material beneath them, and put in another frame. From this, in like manner, another row of spilling-laths is driven in, and another piece of ground removed. The sets of frames are put in so close to each other as to prevent the passage of small stones and clay, but if they are dealing with sand the sets must be very close indeed. Supposing the material to be very bad indeed, it will be necessary to close the ground with breast boards, kept up by struts. In most of these cases it will not do to leave ground unbreasted for a couple of hours, and in some not at all. Then, as each breast-board is taken out more material is removed, and the board is set back a little, and then the next breast board is taken out and set back till room is obtained to put in a fresh frame or durns. The same processes may be required to be carried out at the sides, and in work of this kind, when the ground is mingled with water, the great difficulty will be to maintain the floor, which generally can only be done by sufficient sole pieces.

[Mr. Smyth illustrated the operation of spilling by a considerable number of diagrams and drawings on the board, as well as models.]

LECTURE XXVIII.—It will be obvious from what was said in the last lecture (said Mr. SMYTH) that the process of spilling used for driving through difficult ground is one which requires great caution and accuracy in dealing with the timbering. In very watery ground the level will have to be protected by lining boards or laths, which should not be placed quite close to each other, so as to let some of the water through, and thus relieve the pressure which would otherwise act on the sets or frames themselves. Sometimes in passing out of solid into loose ground of this kind there is a danger of some of the sets subsiding unequally, and causing great risk to the safety of the whole level, and so it has been found necessary to insert longitudinal pieces at the corners—an arrangement which tends to solidify the structure by uniting together the different sets, and so enabling them to resist the pressure when it comes upon them unequally. We have already seen that it is necessary to breast up the ground if it be very insecure, besides the laths driven above and at the sides, but it is occasionally necessary also to drive at the bottom. When this happens the question arises whether the level is or is not to be a permanent one, and whether, therefore, in the former case it will not be well to use brick or stone instead of wood. If, however, the ground be likely to give way it is better to trust to timber, which has a considerable degree of elasticity, and is replaced with facility; but when brickwork or stonework is put in, care must be taken to fill up solidly all the hollow spaces outside the line of the level. Where the ordinary frames or drivages have proved to be scarcely strong enough for the purposes of protection sundry other modes have been suggested and tried. Amongst these is the plan of putting another series of sets within the first, but work of this sort has to be done with the greatest caution and care, to wedge up everything as closely as possible. In many classes of mineral exposure to the air is apt to produce such a swelling of the material as to cause a pressure which scarcely any timber is capable of withstanding. Thus it is that in decomposed quartz, which has this tendency to swell and press the timbers together, frequent repairs are necessary, and continual watchfulness, lest the level be destroyed altogether. In some of the continental mines it has been proposed to build the frames in the form of an ellipse, with horizontal joints, like so much stonework; and a plan being used by which the joints of the timber are made to hold thoroughly well together, the system is said to answer very well. The wood used for this purpose is left rough on the exterior, but squared on the other three sides, and the blocks are from 12 to 15 in. thick. The cost is considerably more than ordinary timbering, but it is applicable and advantageous when the pressure is unusually strong. In the district of Nevada they have had to try various modes of timbering, in consequence of the enormous size of the lodes, the nature of the material, which is so soft that a pick may be easily driven into it, and the tremendous pressure to be resisted. The timbers used are from 8 to 14 in. square; and, as a general rule, used like those with which we are familiar in England. The height of the levels is 7 ft. in the clear, 5 ft. wide at the bottom and 4 ft. at the top, but in some cases the timbering is elliptical, supported by a "lagging," or lining, 3 or 4 in. in thickness. When a level is likely to be permanent, however, it would be better to introduce stonework at once. Attempts have been made to introduce iron and steel under certain circumstances. I mentioned cast-iron props the other day, and in Silesia they have substituted wrought-iron for wood, resting it on sole pieces of timber. At the Freidrich Wilhelm Mine, near a place called Greirberg, a level, in which brick or stonework would have cost per fathom 40 thalers, or 120s., to secure it, was effectually secured by wrought-iron at a cost only of 75s. per fathom.

Several noted attempts to get through quicksands have failed, and it is a great pity that we have no records of the details of those or of other failures which may have occurred, and the reasons why they failed, as such information would enable us to draw conclusions as to what better methods might be taken in future. I must, however, mention a remarkable case in which a serious failure was turned into a triumphant success by the adoption of a different mode of action. In the coal fields of Northern France and Belgium attempts had been made to drive adit levels through certain beds of tourtia, but they had been entire failures, in consequence of the material being in deposits of such large extent, and so completely saturated with water. In the commune of St. Vaast a level to drain a particular colliery district, in a royalty called La Louviere, was commenced in 1747, and in 1843 it had only advanced 1150 metres. Of course, it had not been worked at the whole of that time, but every now and then the attempt had been renewed, until, in 1844, M. Durieux, an eminent engineer, devised a plan which proved successful. Instead of attempting to remove the sand he pushed through it, and thereby prevented those ruinous runs which had followed all the preceding excavations. It was effected by driving the face and sole full of oak pickets, 20 inches in length and 5 inches diameter at the thickest part, boxing in the sides of the level with driving laths. As much advance was made in this way in a few months as it had taken years to effect previously, and instead of having to remove 40 or 50 cubic metres in a given time only 2 to 2¼ cubic metres of sand had to be removed. Another similar case occurred at the colliery and extensive works belonging to the New Vieille Montagne Company, at a place called Engis, on the left bank of the river Meuse, where they wanted to put in an arch 2·60 metres in length and 2·20 metres in width, a large size for a level, and it was found that the best method of carrying out the work was to employ pickets, like those of M. Durieux.

There are one or two points to be noticed with respect to driving large tunnels. If the work is to be done with economy, it should be opened out and secured in such a way that as many men as possible may be employed at once. Nothing was more surprising in working out the famous tunnel at Mont Cenis than the excellent arrangement in this respect, by means of which no fewer than 800 men could be employed. They were grouped into three shifts, and then into gangs, employed in different stopes of work, one set taking a stope out of the floor, and another out of the roof, while others made good and secured the space gained as the work went on. Another remarkable case of a similar kind, carried through under circumstances of great difficulty, is that of the the Thames Tunnel. Many years before that work was undertaken Mr. Trevithick, a well-known mining captain in Cornwall, undertook to carry a tunnel beneath the Thames, and began by driving a small level, as in a mine, by "spilling," to test the character of the ground. It is said he succeeded in getting through about 1000 feet, and took the directors there to see the work. One recalcitrant director refused to believe his statements, and Mr. Trevithick, who, though highly gifted, was an erratic genius, in a fit of rage thrust a bar up into the top of the level, and, being then under the bed of the river, the result of the experiment was that the party had great difficulty in making their escape. The work was afterwards taken in hand by the elder Brunel; he met with almost insurmountable difficulties, and in spite of all his precautions the work was repeatedly swamped. His greatest difficulties arose out of his attempt to carry the tunnel at its whole height and width at once, the dimensions being no less than 38 feet wide by 22 feet high, so as to have two roadways. This would have been comparatively easy in many kinds of rock, but he had to deal with soft sand, gravel, marl, and clay. He succeeded, however, by constantly breasting up the front of the excavation by a strong shield of iron, divided in three stages, and also by vertical ribs, by which each stage was subdivided into eleven small cells. The men worked at each of these cells separately and simultaneously, and having advanced them 4 or 6 in. at a time, closing up their ground bit by bit, and the walls and roof secured by masonry, the shield was then pushed on by means of screws, and the whole structure was advanced in this way inch by inch. The system of opening a small space at once is the best that could be devised, for in all tunnelling it is found that there are dangers which can only be safely encountered by that method. It falls to the lot of miners frequently to have to open out in the levels larger spaces than usual, and the great secret of safety and success in heavy ground is to open out only a small portion at once. It is usual in such cases to drive a small drift ahead through the ground, timbering it for safety; another drift is then driven at the top, with great caution if the ground is moveable, and then other portions are opened, and at length united.

DESILVERISATION OF LEAD WITH ZINC.

During the past few years considerable interest has been felt by metallurgists in the progress of Flach's or Cordurie's process for the desilverisation of lead, especially since its introduction at the Par Smelting Works, in Cornwall. The nature and history of the Pattinson process are so well known that it will suffice to say that Flach's process was designed as an improvement upon that of Pattinson, and that many of our most competent practical metallurgists expressed very favourable opinions as to its merits. Another invention, considered to be an improvement even on Flach's, has recently been perfected by Mr. JAUNEL DE VAUREAL, for which he claims additional economy in time, fuel, and labour. The final specification for the English patent has been lodged by Mr. M. Henry, patent agent, Fleet-street, during the present week, and we take the earliest opportunity of giving the details of the process. The process depends, both as to the bettering and as to dezincage, upon the circumstance that chemical action is in proportion to the surfaces exposed; it is, therefore, by the multiplication of the surfaces of the metals to be purified by oxidation that the process is shortened. Mr. Jaunel de Vaureal considers that an important fact has escaped the notice of previous inventors—that the separation of the triple alloy of lead, zinc, and silver always results from two properties of this alloy, and that these properties equally affect the result. Firstly, its density is not so great as that of lead; secondly, its separation by crystallisation takes place at a temperature above the melting point of lead. These two properties were well known, but the knowledge has not previously been applied in connection with the desilverising of lead. In fact, it is by a series of three crystallisations of the triple alloy, which its lesser density assists, that the rapid and complete separation of the silver is by this process effected.

It is evident that in shortening the process the cost of fuel is lessened, and by the succession of the several parts of the process and the handling of the apparatus the cost of labour is likewise diminished. An essential point, moreover, in favour of this process is that the commercial result cannot vary, and will be uniform, notwithstanding the inexperience of the workmen. It is with this object that there is connected with the practical application of the process a method for securing certainty and regularity of action in the heating flue. For this purpose an electric bell is made to denote each time that the desilverisation has taken place. This is put in motion by the touching of a copper button by the pointer of a Bourdon gauge, generally employed as a pressure gauge, but serving in this case for a thermometer. Practically, the gauge is affected by the dilitation of the air caused by the temperature of the melting-pot. The air is contained in a gun-barrel communicating with the gauge. By regulating this gauge once the regular carrying out of the operation is secured, and that, too, by the metallurgical process itself.

The advantages of the process having been pointed out, the details of the mode in which it is carried out in practice may be explained. The first operation embraces the bettering or refining of the raw lead, which is assumed to contain, iron, tin, bismuth, antimony, &c. The raw lead is liquated in a covered melting-pot, which is connected with a hearth capable of melting 15 tons in four hours. The molten lead is superheated to dull redness. The thermometrical apparatus, described hereafter, sounds a bell when the proper temperature has been reached. The superheated lead in the pot passes into a receptacle, the bottom of which is perforated with capillary orifices and falls in the form of fine rain through the muffle, where it is met by a current of superheated air supplied through a suitable cock from a separate vessel. A pot is provided to receive the metal and the dross, and the vapours are condensed in suitable chambers. The decantation takes place automatically in the pot just mentioned, the lead running off into a receptacle furnished with a syphon for conducting it into the moulds. The discs thus obtained are used in the B pots, or second series of pots. The receptacle furnished with the syphon is also provided with a fixed perforated ladle at the end of a long handle, and charged with a couple of pounds of zinc, the capacity of the receptacle itself being equal to 1 ton of lead. The zincy dross which collects at the top of the receptacle must be treated separately if the raw metal contains gold.

The desilverising proper forms the second operation. The B pots, charged with the bettered raw lead which has already undergone the first zincage, are submitted to a second fusion. For this purpose a movable hearth heats the first of the pair of B pots, and by a set of dampers the heat of the fixed hearth is added to that of the movable one. When the fusion is complete, and the electric bell indicates that the temperature of 365° centrigrade has been reached, one half of the zinc to be used is forced to the bottom of the vessel by means of a strong ladle, furnished with a strong vertical shaft, the upper end of which is attached by the workman to a suitable cross-piece. At this moment the position of the damper is changed so as to invert the order of the hearths, so that the movable hearth and the heat from the fixed hearth pass under the second of the pair of B pots. A similar change is made with the second of the pair of B pots. Then the first pot, skimmed from the zincy dross, and afterwards crystallised, is again molten and zinced again; this is the third zincage. In both of the pots the skimming takes place at 335° centigrade, which is indicated by a different bell, which sounds between 345° centigrade and 350° centigrade. During this signal the workman divides the crust with a pike, and at the proper signal skims the pot, and deposits the crust in the third pair of (C) pots.

When the first B pot has been liquated, zinced, and skimmed twice the workman, placed on a suitable platform, syphons it off. The inside part of this syphon and the first ½ in. of the outside part is cast with the pot, and the longer leg of the syphon is an iron tube screwed to the other, and tightened by a copper washer. Thus made the lead cannot escape at the joint. The extremity of the syphon is also closed by a screw hermetically sealed by a platinum ring luted with chloride of zinc. Under these conditions the air intercepted in the syphon is kept there during the whole operation. This syphon permits of decantation from the B pot, but does not entirely empty it; after each operation there remains about 1-16th in the bottom of the pot. In this part will be found for the succeeding operation all the crystals separated from the alloy—lead, zinc, and silver—which have not combined with the dross, and which by their density occupy the upper region of the liquid metal. The capacity of the B pots is calculated for 16 tons—that is, 15 tons to be decanted, and the ton which remains in the pot. The zinced and perfectly desilverised lead is run into the A pot, where it is immediately superheated as for the first operation, except that the refining of the lead is effected through a perforated screen across a corresponding muffle, having special condensation chambers, so arranged as to separate the fumes of the bettering from those of the zincy lead. The lead, dezinced and pure, passes into a receptacle, whence it is taken, ladle fashion, for casting into ingots with the trade mark upon them. This receptacle must be provided at the front with a stop or weir to prevent running in the ingots too hot.

In the fourth operation the zincy crusts are liquated in the C pots in order to be enriched, the argentiferous lead which is separated from it being passed back into the B pots.

In the fifth operation the rich zincy crusts are molten in a pot and chloridised with chloride of lead. To hasten the chloridisation, which goes on in proportion to the surfaces exposed, a sheet-iron bell, containing logs of green wood, is plunged into the bath. The lateral parts of the bell support iron tubes turned down at the top, and the upper end of which are pierced to form roses at the level of the liquid in the bath of chloride of lead and of zinc. Under the pressure of the gas produced by the distillation of the wood the lead bubbles up to the surface of the bath, and traverses the chloridising ratum in the state of globules. The rich lead is taken off, and the rich litharge serves for making chloride of lead, so as to recover the silver contained. To this rich chloridised litharge is added the impure litharge from the bettering process, and is thus purified by the chloridisation, so that the foreign metals are separated. The fumes from the dezincage of the desilverised lead are partly sold as zinc white, and are partly treated with the dross to regenerate the lead and the zinc. This method of treatment is also applicable to the residues of chloridisation. These residues treated by lime yield a hydrate of the oxide of zinc, and a certain quantity of oxide of lead. We shall take an early opportunity of publishing the results obtained in the practical application of the invention.

FOREIGN MINING AND METALLURGY.

The intelligence received from the Charleroi and Couchant de Mons basins reports a slight diminution of activity in the Belgian coal trade. At the same time, the activity remains relatively great, in consequence of considerable orders which have been given out by the sugar works, the glass works, the iron works, the brick making establishments, &c. Means of transport do not make default, with the exception of the supply of trucks on the Northern of France Railway, which is always insufficient. Freights for Paris remain at 8s. Prices of coal show little variation. From the Liége basin the advices received are very satisfactory; all the collieries are working actively, although there is a slight falling off in the demand for coal for commercial purposes, in consequence of the close of the winter. The Belgian Government has made some fresh regulations with reference to the navigation of the canal from Charleroi to Brussels. The Bonne-Fin Collieries Company will pay, on March 30, a dividend of 14s. 6d. per share for 1871.

The condition of the French iron trade continues favourable; prices remain firm, and are even advancing. The quotations of the principal products, according to the advices to hand from St. Dizier, are:—Rolled iron from coke-made pig, 8*l.* 16s. to 9*l.* per ton; mixed ditto, 9*l.* 4s. to 9*l.* 12s. per ton; charcoal-made ditto, 10*l.* 8s. to 10*l.* 12s. per ton; hammered iron, 10*l.* 12s. to 10*l.* 16s. per ton; machine, No. 20, coke-made, 9*l.* 16s. to 10*l.* per ton; mixed ditto, 10*l.* 16s. to 11*l.* 4s. per ton; ditto charcoal-made, 11*l.* 16s. to 12*l.* 4s. per ton; sheets, coke-made, 10*l.* 16s. to 11*l.* per ton; ditto charcoal-made, 11*l.* 12s. to 12*l.* per ton. From the Ardennes it is announced that the house of Wendel has addressed a circular to its clients, announcing an advance in its products. Rolled merchants' iron is advanced to 9*l.* 12s. per ton, first-class, delivered at Braux, Nouzon, or Charleville. Sheets are quoted at 11*l.* 12s. per ton, first category. Plates are advanced to the extent of 1*l.* 4s. per ton. Pipes are also "majorated" 16s. per ton. Upon the whole, it may be affirmed that the French iron trade is in a flourishing condition at the present time, orders coming to hand from all quarters. The Terrenoire Works are stated to have forwarded last year to the United States Bessemer steel rails to the aggregate value of 30,000*l.* This is the first occasion upon which France has exported to the United States this description of rails, which is in great demand among the Americans. The Châtillon and Commentry Forges Company commenced the payment on Friday of an interim dividend of 10s. per share for 1871.

The Belgian iron trade is still tending upwards. This state of affairs is explained by the scarcity of pig and merchants' iron, as well as by the extreme abundance of orders for all descriptions of products. Pig, hard iron, has brought 3*l.* 16s. per ton, ditto for rails 3*l.* 4s. per ton. The current price for rolled iron in the Charleroi basin is established at 8*l.* 8s. per ton for No. 1, first-class. Ordinary plates are worth 10*l.* 16s. per ton, and boiler-plates 11*l.* 12s. per ton; the latter are especially in great demand. The current rate for rails is 9*l.* 4s. to 9*l.* 12s. per ton, delivered at the ports of embarcation, but this quotation is to a great extent nominal. The Châtelet Rolling-Mills Company fixes the price for first-class merchants' iron (No. 2) at 9*l.* 4s. per ton; and that for sheets at 11*l.* 4s. per ton. An advance is announced in the rates current for minerals from the Grand Duchy of Luxembourg which can only be obtained in limited quantities at 1*l.* 14s. per ton. The municipal authorities of Brussels have been considering tenders for the erection of *halles centrales*. The lowest tender was that of M. Looymans who offered to execute the work for 63,000*l.*, while Messrs. Waring Brothers submitted a tender at 70,000*l.* The result of the competition has not been at present announced. Tenders have been delivered for the supply of steel rails to the Brussels and Luttre Railway. The tenders were for three lots of rails of 450 tons each, and the John Cockerill Company tendered at the lowest price, viz.—13*l.* 7s. 6d. per ton for one lot, 13*l.* 11s. 6d. per ton for another lot, and 13*l.* 15s. 6d. per ton for the third lot. The two first lots are to be delivered at Luttre, and the last lot at Brussels. The rails are to be of Bessemer steel. The Sclessin Company tendered for rails manufactured by the Martin-Siemens process at 14*l.* 11s. 6d. per ton, delivered at Brussels. MM. Adhemar Leroy and Co. offered the same rails at 14*l.* 13s. 11d. per ton, delivered at Brussels, and 14*l.* 15s. 9d. per ton, delivered at Luttre. Contracts for iron rails and other material are to be let on the 22d prox., for the Brussels and Luttre Railway. On the 25th inst. there will also be an adjudication at Amsterdam for 2000 tons of Vignoles rails, with accessories, for the Dutch Railway Company.

The French copper markets have been tending upwards, the advance amounting to about 1*l.* per ton. At Paris, Chilian delivered at Havre has made 87*l.*; ditto in ingots, 92*l.*; tough English, 89*l.*; and Corocoro minerals, pure standard, 89*l.* per ton. At Havre business in copper has been somewhat revived by a sale of 4 tons on Paris conditions, and 50 tons, first marks, upon the same terms. Business in copper is generally good upon the German markets; firmness has been especially observable at Berlin. Tin has been advancing upon the French markets. At Paris, Banca delivered at Havre or Paris has made 158*l.*; Straits ditto, 152*l.* to 156*l.*; and English, 156*l.* per ton; the market has displayed excellent tendencies. Prices have not notably varied upon the German markets, which have been rather slow in following the example of the French centres. The Dutch Society of Commerce will hold its next sale of tin on April 11; it will take place at Rotterdam, and will comprise 52,800 ingots of Banca and 2600 ingots of Billiton. The society will not offer any more tin for sale until the ordinary sale in the autumn. Tin has been advancing at Rotterdam; Banca and Billiton, under sail, have been dealt in at 90 fls. The Dutch and German lead markets have not experienced any variation. At Rotterdam, Spanish lead has been dealt in at 11¾ fls.; Stolberg and Eschweiler, at 12 fls.; and German, of various marks, at 11¾ fls. At Paris, Silesian zinc, delivered at Havre, has made 26*l.*, and other good marks, delivered at Havre or at Paris, at 24*l.* per ton. These figures show an advance of 4s. per ton. At Marseilles, Vieille-Montagne zinc in sheets has brought 30*l.* per ton, and other good marks 29*l.* per ton. In Germany, upon the principal markets (Breslau and Hamburg), the tone of business has been quiet, and quotations have been almost nominal.

FLAGSTAFF SILVER MINING COMPANY.

Supplementing the report which appeared in the Supplement to last week's Journal, the following communication has been received from Mr. N. M. Maxwell:—

Salt Lake City, Utah, Feb. 17.—Agreeably with your instructions, I have handed over to Mr. Hill the mine, and to Mr. Patrick the furnaces, on your behalf. I much regret to inform you that the continued snow-storms have all but entirely suspended operations here; the road from the mine to the furnaces has been simply impassable for the last 30 days, and remain so until the snow melts down a little, and no ore can be got to the furnaces in the meantime. Snow slides, with serious loss of life, are frequent in the canyons, and even if a road were broken through the snow it would be a work of danger to travel over it. There are fortunately plenty of stores for the sustenance of the men at the mine. I hand you herewith letter of instructions given to Mr. Hill, and on my return to London will verbally inform you upon all points connected with the same. The furnaces I found had been allowed to get out of repair during the past few months of working, and they require additions, in consequence of which I obtained, after considerable negociations with owners, a sum of $7000 to effect these repairs and to assist in the erection of a third furnace, &c. I hope that this work, so far as regards present furnaces, will be completed in a fortnight from now, so that they may be started up, and kept going continuously. There is enough ore on hand to keep them running for 10 days, but great difficulty exists in obtaining supplies of charcoal, on account of the railroad blockade. Mr. Patrick will, however, overcome this in a measure by getting small quantities from different parties in the valley sufficient to enable the furnaces to run for a month after they are repaired. By this time it is hoped that the snow blockade will have terminated, and regular supplies of ore and coal come forward. When the third furnace is in operation, in about two months, two furnaces can always be kept running, and one idle for re-lining and requisite repairs needed from

time to time, and by this arrangement the idle time lately will soon be made up. Mr. Patrick is making arrangements for contracts for regular supplies of charcoal during the rest of the year. When the mine and furnaces are in proper working order an average profit of $2000 per day, all the year round, should be made, notwithstanding occasional weather and other interruptions. Mr. Patrick and myself have had full discussion as to the future working of the mine in reference to the rules and regulations at the mine and furnaces, the forms of accounts, vouchers, &c., and I believe that our arrangement will meet with your approbation. The pay will be made in future at the mines and furnaces monthly, instead of as at present, bringing the men to Salt Lake City, 25 miles, to receive it. All these alterations will take time to get in good working order, but in three months I believe the Flagstaff will be the best managed mine in the district. The furnace manager appointed by Mr. Patrick brings with him good testimonials, and he appears to me a very active and intelligent man. He will have no difficulty in his work, for the Flagstaff ore is the easiest reduced ore, and the Flagstaff furnaces have been more successful and regular in their operations than any others in the territory. I trust the weather will soon improve, and that the property will come fully up to the anticipations of those interested, of which I have no fear under good management at the mine and furnace.

FOREIGN MINE.

The Linares Lead Mining Company (Limited) have declared a dividend of 5s. per share; the Fortuna Company (Limited) a dividend of 3s. 6d. per share; and the Alamillos Company (Limited) a dividend of 1s. per share, payable in each case on April 6.

ST. JOHN DEL REY.—The directors received the following report, dated Morro Velho, Feb. 17: Morro Velho produce for January, 10,991 oitavas, from 4654 tons ore; yield, 2·361 oitavas per ton. Morro Velho cost for January, 5080*l.*; loss, 693*l.* Morro Velho produce eight days of February, 2338 oitavas; yield, 2·157 oitavas per ton. Gaia produce for January, 678 oitavas, from 500 tons; yield, 1·356 oitavas per ton. Gaia cost for January, 329*l.*; Gaia loss, 43*l.*; Gaia produce for eight days of Februay, 201 oitavas; yield, 1·006 oitavas per ton. Water lowered in new shaft 15 days in February, 24 feet.

DON PEDRO.—The report for January states that the produce is 10,179 oitavas, at 8*s.* 6*d.* per oitava, 4326*l.* 1*s.* 8*d.*; cost, 3308*l.* 15*s.* 10*d.*: profit, 1017*l.* 5*s.* 8*d.* For the first division of February the produce to date is 4220 oits.; remittance, 20,017 oits. They have a good force, and a full supply of ores is being raised. The boxwork obtained for the last two weeks has been taken principally from the northern part of No. 6 shoot underneath the curve. The line in Canoa has not been available, owing to the stopes being large and rather hard for breaking, but they hope to extract from it in a few days, and as when last left it had much improved they expect to get some good work. The line of gold (No. 6) being in water is under suspension, consequently vein stuff for the fortnight has been limited. The Canoa general work has improved a little in quality, and altogether the stopes in appearance and quality are fair; the line in the southern stopes, descending on No. 8, being poor for boxes has been embraced in general stoping. On account of the continuous heavy rains causing the ground in Vivian's shaft near the surface to swell and break some of the timberwork crushed last night, but every measure is being taken to repair it again as quickly as possible. This will no doubt hinder hauling from the bottom of the mine for a few days, during which time the supply of ores from this section will be interrupted.

ROSSA GRANDE.—The report for January states that the sanitary state of the establishment, in view of the season of the year, has been very favourable. Very fair progress has been made towards developing the Bahu and Cachoeira Mines. All the force employed at surface is confined to such work only as is absolutely necessary for carrying on and facilitating our underground operations. The increase of force on that of December is an average of 17 per day. The produce of gold for the month amounts to 572 oits.—Bahu: The lode in the bottom of sump-shaft is about 1 ft. 6 in. wide; it appears in this part of the mine as the lode becomes small that it is less auriferous, but, judging from the favourable indications it presents, it is thought it will soon open again; 2 fms. 6 in. have been sunk during the month.—Cachoeira: The lode in Richards's shaft is about 2 ft. wide, producing stamping work of rather low quality; good progress is still being made in sinking, 6 fms. having been accomplished during the month. For the first division of February a remittance is reported of 1218 oitavas of gold dust, produced during December and January.—Corrego: The cost for treating the Corrego stuff last month was less than 21*l.*, for which they had 129 oits. of gold; seeing that it will pay, it will be worked on a larger scale.—Bahu: The lode in the sump-shaft is improving; it is now about 2 feet wide. In the other parts of the mine there is no change worthy of remark.—Cachoeira: At Richards's shaft the ground is favourable, and water as yet is very little. No noticeable alteration has taken place in the quality of the lode.

GENERAL BRAZILIAN.—The report for January states that at the old adit small shaft No. 1 has been sunk and level and cross-cuts driven. The shallow adit No. 1 is still favourable for driving. Haymen's shaft is resumed. At Itabira the shallow adit is still wet and troublesome to handle. The middle adit is about the same as when last advised. Moore's shaft is under suspension. Souza's vein is at present poor. The surface-works are progressing. The health of the establishment is good, and materials and provisions plentiful. The produce for January is 228 oits. For the first division of February it is stated that at St. Anna old adit, after suspending operations in search of the shoots until the ground is further drained by shallow adit No. 1, they decided to send to surface some auriferous jacotinga that was calculated would do for the stamping-mill. In so doing we opened on a small portion of jacotinga that looked very promising; it was taken to the wash-house, and weighed 6 cwts., and passed over strakes, which produced 112 oits. of gold, one piece weighing upwards of 2¼ ozs. The surface-works are advancing. The health of the establishment is good, and materials and provisions plentiful. The produce since last advised is 208 oitavas.

ANGLO-BRAZILIAN.—The report for January states that the produce from Passagem for the month amounts to 930½ oitavas (or 107 ozs. troy); and cost, 587*l.* 18*s.* 10*d.* The produce exceeds that of last month by 121 oitavas. Fair and average raisings of stone have been derived from level 44 Dawson's, as also from stopes in arch of ground at Dawson's lower western section. The concentration of jacotinga on a small scale has proved very satisfactory, and measures are now being taken to lay permanent launders for bringing a supply of water directly over the deposit, when large quantities can be treated. It is hoped to have everything complete within the next three months. The cost at Pitangui for the month, 698*l.* 16*s.* The last samples washed from bottom of the shaft show small grains of gold. For the first division of February a remittance of 1740 oitavas is reported.

TAQUARIL.—Capt. W. H. Martin reports for January that the works generally have advanced steadily, and fair progress made at the various points throughout the mine, but the produce has not come up to expectations, owing principally to the gold-bearing veins not having yielded any box-work during the month, and the jacotinga line in the 25, south of No. 1 lode, producing very little gold, they have ceased working at this point, and directed the force to work for produce on the No. 2 lode, in the 25 west of Haymen's shaft, near the junction, from which they anticipate better results. The trial stuff, of which about 80 tons have been treated from the formation near the stamping mill, yielded a little gold, but not in sufficient quantities as yet to pay for returning. For the first division of February a remittance is reported of a box containing 920 oits. of gold dust, the produce of December, January, to February 8. At the junction of lodes in the 25 fm. level, west of Haymen's shaft, the prospects are very encouraging, and the lode of a promising character. During the last few days some excellent samples of gold have been taken from the end, on the south part of the lode; this point is 18 fathoms west of Haymen's shaft, and any new shoots or discovery being made in that direction will be found in whole to surface.

EBERHARDT AND AURORA.—The directors have received a telegram from Nevada reporting that the improved value of the assay of the ore passing through the company's mill is fully maintained.

PINTO (Silver).—Capt. Plater reports (March 19) that owing to the almost unexampled severity of the weather he has been unable to transport ore from the mines to the mill, and he has, therefore, been obliged temporarily to suspend all milling operations.

SAO VICENTE.—A letter, dated Feb. 16, says:—The deep adit is a little troublesome for driving, owing to the crushed state of the ground, and the quantity of water issuing from same. However, all things considered, fair progress is being made, the ground towards the bottom of the level will do to pass through the stamps as soon as they have one. Timber is being brought in in abundance. Everything is going on very satisfactorily, and the health of the establishment is very good. The stuff broken down from the foot and hanging-wall, for the purpose of putting in tramroad was passed through the stamps, and gave 50 oits. of gold. They have now commenced to stamp from the line, of which they can see gold in some of the stone in breaking. It is intended to sink the shaft, as it is thought the line is about to undergo a change for the better. Satisfactory progress is being made with the new stamps. The health of the establishment is very good.

BATTLE MOUNTAIN.—Feb. 8: Bishop's winze, about 25 ft. west of the shaft, sinking below the 113 ft. level, and down 47 ft. below it, contains no ore, except traces of silver. This makes the total depth of this mine 160 ft., or more than twice the depth it was on my arrival. The winze is for the time suspended. The 113 cross-cut east, towards Lake Superior, is again resumed, at $7 per foot, the company providing all board, &c. The ground is one mass of iron pyrites. If we can get this through to Lake Superior it will increase our ventilation of both mines, and we can from it prove the L. S. lode at 135 ft. deep cheaper and better than by any other mode, and was highly approved by Capt. Nancarrow, who, on his arrival in England, will be able to enlighten you on all points. He spent a week here on his last visit. The stopes in back of the 113, north of Roach's winze, are poor, and if no improvement takes place will be shortly abandoned. The stopes in back of this level, south of Roach's winze, turn out large quantities of orey work, much associated with gangue, requiring much assorting, but is a fine lode. In the back of the 113 north, at Truscott's winze, we are opening the ground for stopes; no lode has been taken down yet. In the 73 north, some distance behind the end, we are blasting out the side, and finding good orey work. The stopes from below (the 113) will throw light on this as they come up.—Lake Superior: The back of the 70 ft. level, south of Pryce's shaft, has been set on tribute, at $1 per unit, we finding board and all material. If they raise no ore, we get the ground explored and tried at a comparatively small cost. If they make a discovery of ore we shall be greatly benefited as well as they. During the week 629 sacks were raised.

Feb. 15.—Virgin: In the 113 cross-cut, eastward towards Lake Superior, the ground, I regret to say, continues very hard—iron pyrites, with a small gouge, or leave-go, in the centre about 1 inch wide. Had it not been for this there would be very great difficulty in making any headway whatever. I am hoping for a change here for the better. The stopes in back of the 113, south of Roach's winze, continue to produce a good deal of ore, mixed with gangue, troublesome to separate; but this may get less so at any time. In the 73 north the eastern side still produces orey work, and is promising.—Lake Superior: At the 135, this mine having been deepened 65 ft. since my arrival, we are cutting into the lode, to prove its size and character; and I have broken some very rich stones of ore, and it looks at present exceedingly promising. It is to be enabled to work this economically, and at the same time expeditiously, that the cross-cut from the Virgin hereto is being put out. During the week 550 sacks were raised.

Feb. 22.—Virgin: The cross-cut eastward towards Lake Superior is hard and slow of progress, but it is now showing some indications of a change for the better. The stopes in the back of the 113, south of Roach's winze, have turned out some very indifferent ore of low produce; and the two last parcels of ore are considerably affected thereby. An improvement in quality has, I am glad to say, again taken place. At the 73 north, in the eastern side of the drift, a large lode of low-quality ore has been laid open, which requires cheaper process to work effectually, but which we shall work in as best we can. Thomas's rise, in the back of the 73, has been communicated with the 37, and we are now taking down the lode, which produces some good paying ore.—Lake Superior: A cross-cut has been put out westward through the lode, for proving its size and character. It proves to be several feet wide, containing ore, iron pyrites, and gangue. A drift is now commenced southward on its course, and from all appearances we have a right to expect some good pay ore from it; it is a very promising lode. There were 630 sacks raised during the week.

BRAGANZA.—Morro Tabac, Feb. 15: Operations since the Christmas holidays have progressed fairly. The lodes in B and C cross-cuts are pushed forward, and although auriferous are not at present rich. Descending lower down the hill to the deep adit, marked A (still 400 ft. from the base), in resuming work on No. 1 lode, driving north, at first it was found small, but after driving a few feet it began to increase, and is now 2 ft. big, widening as it extends northwards. There is a rather large stream of water issuing from it, and the lode is promising in appearance; the samples taken from it are pretty good.—Jacotinga Lode: On cutting down some timber last month close to the limits of the property a jacotinga formation was discovered in exploring, and found lines or veins perfectly defined running north and south, dipping easterly; we have traced the formation several miles north, and the composition of the jacotinga appears to be precisely of the same nature as that of the mines which have already been explored—Don Pedro, St. Ann, and Gongo Soco—its component parts being iron ore, manganese, mica, and decomposed quartz. The lines are most clearly defined; we have washed samples from several of them, and the majority show gold in the bowl, proving the jacotinga to be auriferous.

EXCHEQUER.—California, Feb. 20: The main tunnel in 519½ feet. Narrow streaks of ore assaying from $15 to $120 per ton show themselves in the face and roof. The east drift towards the Accacia is in 61½ feet. The bedrock begins to get mixed with quartz.

I. X. L.—California, Feb. 20: The purchase of this with the Buckeye, Norfolk, and other mines adjacent has been completed, and the new company in possession. Pending full instructions from the board, there being good indications in the face of the old lower tunnel, a contract has been let to continue the same on the footwall for 200 feet, and work commenced on the 18th ult. While clearing out preparatory to driving, a cave of the ground some 20 ft. high and about 30 feet from the face disclosed stones of ore assaying $108·77 per ton. Some pieces from the other dumps give $850 per ton.

ECLIPSE.—The report, under date Feb. 19, from Mr. H. Tregellas states that they commenced smelting on Feb. 5, and after running three days the roof of the roasting furnace failed, the fire-rock not being of the right material. He then sent teams to Cerro Gordo (24 miles) and got a few loads of the firestone used at the many furnaces at that place, and which have stood the almost constant smelting for 12 months, and is better than when first built. They have the same material, and our furnace is running first-rate, and all things considered, he is glad they had the break down, as they have made some alterations that save one-half the firewood, and the furnace now works as well, if not better, than any furnace in the country. They were keep at it day and night. At the mine all goes on well, without let or hindrances, having no difficulties whatever. The lode in the 300 feet level has somewhat improved since last report. The stopes above said level produce the same as heretofore. Bluett's vein of silver has yielded well, and if it continues so to do they will turn large amounts of silver.

SNOWDRIFT SILVER MINING AND REDUCTION.—Ernest Le Neve Foster, March 5: The mine is now looking exceedingly well, and all the stopes, except one, show more ore than I have yet seen in them. On Monday I shall be able to go to the bottom of the shaft, and can then report to you how the mine is looking at its deepest point. I have now another shipment of ore ready, but I cannot make it till I get sacks, 500 of which are now on their way here.

STAR OF NEVADA (Silver).—E. Ernest, Feb. 22: Report for January: During the month 50 ft. of the east level was completed, at a cost of $5 per foot, exclusive of supplies. There is no material change in the ledge since my last report. I have let a contract to run 50 ft. east, the lessees to retain one half the ore extracted in running ahead, the company to furnish all supplies. The main tunnel has been driven ahead day and night, the rock proving very hard; 30 ft. of the contract remains to be completed. During the last 100 ft. driven two ledges have been cut. I have not had any work done on the last one cut, from the fact that it could not be done to advantage yet. From the appearance of the ledge I feel satisfied that it will prove valuable when once opened. With one exception all the lessees mentioned in former reports are at work, with very fair prospects. In sinking they have a great deal of water to contend with, making their progress slow. The exception mentioned is where the parties sank 60 ft. from the level, and were compelled to abandon their work on account of water, leaving good ore in sight. The main shaft once down the water can be easily managed from all parts of the mine. The amount of ore taken out by the company thus far is about 15 tons ready for mill, that of lessees about 16 tons, of which the company retains one-half. I estimate the value at $300 per ton. I have opened a breast 60 ft. on ledge, but as yet have had but two men employed in stoping out. More cannot be worked to advantage until the completion of tunnel and level. I leased a portion of what is known as the Hazel Green ledge, to be worked from the surface down on the ledge; they are now down 55 ft., and have struck a fine ledge varying from 10 to 20 in., showing some very fine ore, and when properly opened a large amount of ore can be taken out in a short time. The parties hold lease for six months, the company retaining one-fourth of all ores, and not to furnish any supplies. The total expenses for January, including $250 paid for running 50 ft. of level, and $60 for driving 12 ft. of main tunnel, was $1281. The expense for running the mine during the present month, from all sources outside of the tunnel contract, will not exceed $500.

ANGLO-ARGENTINE.—J. Vivian, Jan. 22: Permanent stamping with 12 heads commenced on the 8th inst., and the temporary shafting for arrastres which we are making here is nearly completed, therefore I shall probably inform you in the course of a few days that we have commenced amalgamating. The second 12 heads of stamps will be, I think, ready to work in March, after which the remaining 12 heads will be completed. With 36 heads of stamps we shall undoubtedly crush 1500 tons of ore per month, which would give us, even with low quality ore, a handsome profit.

ALAMILLOS.—March 13: The lode in the 60, driving west of San Rafael's shaft, is large, but quite poor. The ground appears to be slightly improved for driving through in the 50, east of La Magdalena's shaft. The 75, east of Taylor's engine-shaft, will hole to the level coming from Magdalena shaft in a day or two. The 85, driving east of Taylor's engine-shaft, is going through a large strong lode, worth ¼ ton in a fathom. In the 85, driving west of Taylor's engine-shaft, the lode is coarse and vughy, and does not contain sufficient lead to value. The lode in the 50, driving west of San Yago shaft, has improved in size and value, containing good lumps of lead, intermixed with carbonate of lime, yielding 1 ton of ore per fathom. In the 40, west of Rica's winze, the lode has fallen off in value, but is still good in the back of the level, worth 1 ton in a fathom. The lode in the 40, east of San Victor's shaft, is very wide, and the ground easy for driving through, yielding large rocks of lead worth 2 tons in a fathom. The lode is small and poor in the 50, driving east of San Victor's shaft. The 40, driving west of San Victor's cross-cut, is opening out very good tribute ground, yielding 2 tons in a fathom. Nothing new has been met with in the 50 fm. level cross-cut, south of San Victor's shaft. The lode in the 20, east of Addis's shaft, is split up into several branches, worth ½ ton in a fathom. In the 40, east of Crosby's shaft, the lode has somewhat improved, but its being so wet impedes very much the driving, yielding 2½ tons per fathom. The lode is small and poor in the 50, east of Crosby's shaft. In the 40, west of Crosby's cross-cut, the men are put to drive a cross-cut to Morris's shaft. The lode is large in the 50, driving east of Crosby's cross-cut, but quite unproductive. The lode in the 50, west of Crosby's cross-cut, has come in contact with several heads, which have quite disordered and impoverished it.—Winzes: The lode in Cobo's winze sinking below the 30 in compact and regular, yielding 1 ton to a fathom. The lode in Lazaro's winze, sinking below the 40, is not quite so productive as it has been, yielding 2 tons in a fathom.

LINARES.—March 13: The lode in the 85, driving west of Crosby's shaft, contains a little ore, but not enough to value. There is no improvement in the 75, driving west of Crosby's shaft. The lode in the 75, driving west of San Francisco's shaft, is of a promising appearance, consisting of carbonate of lime and lead ore, yielding of the latter 1 ton in a fathom. In the 75, driving east of San Francisco's shaft, the lode is small, composed of quartz and lead ore, yielding of the latter ½ ton in a fathom. In the 65, west of San Francisco's shaft, the ground is hard, and the lode disordered and poor. The lode in the 55, driving west of San Francisco's shaft, is compact and regular, and yielding good stones of ore, worth ¾ ton in a fathom. The lode in the 45, driving east of San Francisco's shaft, is small and poor.—Los Quinientos Mine: The lode in the 65, driving west of Taylor's engine-shaft, is improving in appearance, yielding a little lead ore. In the 55, driving west of Taylor's engine-shaft, the lode has fallen off in value during the past week, now worth ¾ ton in a fathom. The lode in the 65, driving east of Taylor's engine-shaft, is large and strong, producing good stones of lead ore, worth ½ ton per fathom. The lode has improved in the 55, driving east of Taylor's engine-shaft, and now presents a kindly appearance, yielding ½ ton of ore per fathom. In the 45, driving east of Addis's shaft, the lode is large, consisting of carbonate of lime and lead ore, yielding of the latter ½ ton per fathom. The lode in the 45, driving west of San Carlos shaft, has a very promising appearance, yielding ¾ ton in a fathom. In the 55, driving west of San Carlos shaft, the lode has been changeable, varying from 2½ to 2¾ tons in a fathom, and is now worth ¾ ton in a fathom. The 54, driving east of San Carlos shaft, is hard, and the lode unproductive at present. The lode in the 45, east of San Carlos shaft, is of a very kindly character, and shows indication of further improvement, producing 2½ tons in a fathom. In the 32, driving east of San Carlos shaft, the lode has fallen off in size and value, now worth ½ ton in a fathom.—Shafts and Winzes: We have commenced sinking below San Carlos engine-shaft below the 55 for bearers and cistern. Salvador's winze, below the 32, is hoisted to the 45, producing 1½ ton in a fathom. The lode in Perez' winze, sinking below the 32, is producing a little lead, but not enough to value. Garcia's winze, below the 45, is going down in a strong, open, productive lode, worth 3 tons in a fathom.

FORTUNA.—March 13: Canada Incosa: The lode in the 110, driving west of Henty's shaft, is small and valueless. The lode in the 100, driving west of Judd's shaft, is small at present, worth ½ ton of ore per fathom, but shows signs of improvement. In the 80, driving west of Henty's, the lode is now very small. The lode in the 60, driving east of San Pedro's shaft, is of a promising appearance, consisting of quartz, clay, and lead ore, worth of the latter 2 tons per fathom. In the 90, driving east of Addis's shaft, the lode is composed of quartz and carbonate of lime. In the 80, driving west of Lowndes' shaft, there is a good lode in the bottom of the driving, yielding 1 ton of lead ore per fathom. We are driving north of the 80, east of Caro's shaft, to find the lode on the eastern side of the cross-course.—Shafts and Winzes: The sinking of Lowndes' shaft below the 80 is resumed; the lode is a little to the north of the shaft. Serrano's winze, sinking below the 70, worth 2 tons of ore per fathom, is temporarily suspended, in consequence of an increase of water. Picou's winze, sinking below the 100, is going down in a powerful and productive lode, worth 2 tons of ore per fathom. Carlos winze, sinking below the 90, is situated west of Judd's shaft, and is going down in a very good lode, worth 2 tons of ore per fathom.—Los Saidos Mine: The lode in the 110, driving west of Buenos Amigos shaft, is improving a little, worth 1 ton of ore per fathom. In the 100, driving west of San Carlos shaft, the lode is small, and the ground hard for driving, yielding ½ ton of ore per fathom. The lode in the 90, driving west of San Carlos shaft, is small and unproductive. The 110, east of Buenos Amigos shaft, has just passed through a strong cross-course. In the 110, driving east of Morris's engine-shaft, the lode has fallen off a little, but still has a promising appearance, yielding 1 ton of ore per fathom. The lode in the 100, driving east of San Pablo shaft, is large and strong, and rather hard for driving through, yielding 2½ tons per fathom. In the 90, east of San Miguel's shaft, the lode consists of calcareous spar and lead ore, yielding of the latter 1 ton per fathom. The lode in the 35, driving west of Palgrave's engine-shaft, is com, and solid, worth 2½ tons per fathom. In the 35, driving east of Palgrave's engine-shaft, the lode is divided into small branches, which let out the water freely.—Winzes: Augustin's winze, sinking below the 100, will be holed to the 110 in the present month; is now produces ½ ton of ore per fathom. The lode in Medina's winze, below the 25, is split into small branches, worth ½ ton of ore per fathom. In Lorraine's winze, sinking below the 90, the ground is hard for sinking, and the lode very small, worth ½ ton per fathom. The men are making good progress in Moran's winze, sinking below the 100, which is producing 1 ton per fm. Carlos winze, sinking below the 25, is being sunk through a very valuable lode, worth 3 tons per fathom. In Gabriel's winze, sinking below the 100, the lode is strong and regular, consisting of carbonate of lime, quartz, and lead ore, yielding of the latter 1¼ ton per fathom. The tribute department produced the usual quantity of ore in the past month, and the stopes are moderately well at present. The surface works are going on very regularly, and the machinery is in excellent condition. We estimate the raisings for March at 350 tons.

[For remainder of Foreign Mines see to-day's Journal.]

MINING IN AUSTRALASIA—MONTHLY SUMMARY.

GOLD.—Affairs at the Ulooloo gold field are again going ahead at some speed. On Jan. 24, 150 persons were there, and it is expected that 60 more people have joined them. Some men are doing very well for a South Australian diggings—that is, making good wages. What the majority will earn it is impossible yet to conjecture. At all events, payable ground has been found running two miles long, and in this all the gold is shotty, and often found mixed with pink-looking quartz. Mr. Peterswald, the Warden, has received a letter from Mr. W. F. Coglin, Crown Lands Ranger, stating that there are about 200 persons at work, all getting gold. He wishes the Warden to go up as soon as possible, as he expects a rush. Trooper Smith, who has just come back from Ulooloo, was informed by several persons their average earnings for some time back had been 4*l.* per week. A few Victorian diggers have just arrived on the gold fields. About 8 ozs. of gold, besides specimens, were sent home by the last English mail from the River Torrens Gold Mine, which is being worked by a company composed chiefly of English capitalists, with very promising results. The scene of Mr. Bennett's gold find, near Mount Crawford, has been inspected by Mr. Peterswald, the Warden, in whose presence the prospect mentioned in a telegram already published was washed. The trial yielded from two buckets of stuff 16 dwts. 3 grs., but one lump weighed nearly 12 dwts. In the neighbourhood about 12 miles of the ground has been prospected, and partly worked by the Messrs. Scott and others, who have claims on private land. The sinking is from 3 to 5½ ft. deep, on a clay bottom, and there is (say) 1 ft. of wash dirt.

COPPER.—In August Mr. H. C. Gleeson carried, in the House of Assembly, a vote of 300*l.* "for the purpose of obtaining a scientific report on the mineral wealth of the country 250 miles north of Port Augusta." The Government engaged for this purpose Mr. Ulrich, of Melbourne, who started for the North on Jan 14, accompanied by Mr. A. B. Cooper, the deputy surveyor-general, and Mr. Alfred Nicholls, a surveyor, and three men. The first two gentlemen pushed on by mail to the Blinman, to occupy themselves in an examination of the mineral country in that neighbourhood, while their vehicles and outfit followed them up under the charge of the rest of the party. They will travel from the Blinman to Yudanamutana, examining the country by the way, and then extend their inspection still further to the westward. The whole expedition is expected to occupy a month, and we understand it is intended that Mr. Ulrich's examination will be directed more to the value of existing mines than to the general character of the country. On Jan. 15 Prof. Ulrich, in company with Mr. Cooper, the deputy surveyor-general, and Mr. Nicholls, left Blinman for the Far North Mines, *via* Oratunga, Warrioota, and Sliding Rock, to Yudanamutana. On the 18th they left the Sliding Rock Mine on their way up the country. The mineralogist has so far expressed himself as highly pleased with all he has seen, and satisfied as to the richness of the country.—*South Australian Register.*

AUSTRALIAN MINES.

YUDANAMUTANA (Copper).—The directors have advices from Mr. Martin, dated Blinman, Jan. 22 and 29 respectively, with draft for 75*l.* He states:—"I am sorry to say that on the night of the 15th inst. one of the most dreadful storms I ever witnessed occurred, which has tended in a serious loss to the company, and prevented our doing so well this month as we anticipated. Our smelting works were flooded, the water running through them like a large river, sweeping all before it. We have lost over 30 tons of our richest ore, about 400 tons of wood, and other damage, and all in the space of an hour or two. The loss of the wood will not much affect us, as we have, most fortunately, sufficient on hand for some time, indeed a great deal more than we shall require before drays can travel again. You must not look gloomily upon this news, for although it is unfortunate, there is nothing but what we can overcome." Mr. Ulrich, the mineralogist employed by the Government to examine the North, with Mr. Cooper, the Deputy Surveyor-General, arrived here on the 14th inst., and hence they will commence their explorations. Mr. Ulrich, Capt. Terrell, and myself went underground, and a most complete and thorough examination of the mine took place, and I am sure from the observations he made use of that he was astonished at what he saw. They will call here again on their way down, and upon their report will depend the revival or otherwise of the Port Augusta Railway scheme, which, I think, we shall yet carry. I have aroused some very strong interests in its favour, and am in constant correspondence about it, but the dissolution of the House and the elections have greatly interfered in the movement.

— Jan. 29: Since I wrote you this day week we have put all matters right from the injury caused by the floods. We have four furnaces in full operation, all working well, and turning out a fair proportion of metal, and we have abundance of ore to keep them going. I am, therefore, well pleased with present appearances and future prospects. We are now cutting the cistern plat at the 50, and preparing to put down the remainder of the pumps, as well as all necessary dressing machinery, which shall be started with all possible dispatch. I look forward to the best possible results from this branch of the mine. The superintendent (Mr. R. A. Fiveash) died from an attack of apoplexy on Jan. 27. Capt. Terrell reports—"Blinman Mine, Jan. 22: Hill's Lode: We have scarcely done anything on this lode since my last report on account of the water, and until the engine-shaft is down deep enough to drain it effectually we shall not be able to do anything of consequence here. The last fortnight I have put on six more men to stope away some of the carbonates at the 10 and below the 25; from these places I shall be raising some good carbonates, which will greatly assist us in smelting our sulphurets. Our make of copper for the month is small, owing to the loss of eight days through the holidays, and five more from the dreadful weather we have had, so that, in fact, we have only been working the furnaces for 11 days since my last report, and in that time the copper made was 19 tons 5 cwts.

PORT PHILLIP AND COLONIAL (Gold).—Clunes, Jan. 31: The quantity of quartz crushed during the four weeks ending Jan. 3 was 4522 tons; pyrites treated, 15 tons; total gold obtained, 1049 ozs. 5 dwts., or an average per ton of 4 dwts. 15 grs. The receipts were 3978*l.* 15*s.* 9*d.*; payments (including 1267*l.* paid on firewood and timber account, and 256*l.* on account of concentration of plant), 4813*l.* 7*s.* 7*d.*: loss, 836*l.* 11*s.* 10*d.*, which deducted from the balance brought forward from last month of 983*l.* 7*s.* 1*d.*, left a balance of 146*l.* 15*s.* 3*d.*, which was carried to next month's account. The return for the two weeks ending Jan. 17 was as follows: Quartz crushed, 2214 tons; pyrites treated, 30 tons; total gold obtained, 634 ozs. 19 dwts., or an average per ton of 5 dwts. 17½ grs.

Telegram, dated Galle, the 20th inst., in anticipation of the mail leaving Melbourne on the 1st inst., and due here on April 15:—Month ending Jan. 31, yield per ton 5 dwts. 10 grs.; month ending Feb. 28, yield per ton 4 dwts. 10 grs.

YORKE PENINSULA.—We understand that the 3550*l.* of debentures proposed to be issued by the company have been fully subscribed for, and that instructions will go by to-day's mail to the committee at Adelaide to set to work vigorously in developing the 17½ fathoms of ore ground in the 25 west of Deeble's Shaft. We heartily wish the efforts of the company may be attended with success, and are glad that the rise in the copper market promises to assist them very much.

ENGLISH AND AUSTRALIAN (Copper).—Port Adelaide, Feb. 2: The quantity of coal at Port Adelaide and afloat was about 1133 tons. All the furnaces at Port Adelaide were in full work—three smelting, four roasting, and one refining. The 255 tons copper advised by last mail as in course of shipment had been shipped as also a further quantity of 100 tons, and there were 62 tons in course of shipment at date of advice.

AUSTRALIAN UNITED.—Mr. Kitto writes (Feb. 1):—Relative to Central Mine, I fear that the continued accidents to the pumping gear will so retard the progress towards the gutter, in consequence of the continued rushes of drift sand caused by the water rising to the upper drifts, that a considerable sum will be necessary to thoroughly prospect it. I shall be guided entirely by the next week's work as to whether I continue or stop, pending further instructions from you.

SCOTTISH AUSTRALIAN.—The directors have advices from Sydney, dated Jan. 30, with reports from the Lambton Colliery to the 27th of that month. The sales of coal for the month of December amounted to 9602 tons.

ANGLO-AUSTRALIAN.—The directors have received advices dated Fryerstown, Feb. 1. Mr. Kitto writes:—"The works at the mine are progressing with the greatest regularity. The sinking, as you will observe by Capt. Rabbecks' report, is rather slow; the great desideratum here is now to go as deep as possible, and our principal aim is to do so. When the stampers are ready we shall have ample stone to keep them supplied, and that of a remunerative quality. It must not be forgotten, however, that our eventual success depends on depth, as does every quartz mine in the colony—a fact now being daily demonstrated." Capt. Rabbecks reports (Jan. 31):—"I have the honour to report progress since the 2d inst. No. 2 engine-shaft west has been sunk 12 feet since last report, and secured with timber to a depth of 31 ft., including a frame set of timber, 8 in. by 8 in., for bearers. Shaft now timbered to a depth of 192 ft. Sinking has been through hard, compact sandstone. No change in country. Total depth, 207 ft. South shaft, same line, has been sunk 42 ft., and secured with timber to 102 ft. From 46 ft. cross-cut sinking has been principally through sandstone, interspersed with small slate runs and leaders of quartz every 2 or 3 ft., varying from 4 in. to 18 in. thick, the latter being heavily charged with mundic stopped working, as we are now down to water; present depth, 111 feet. Intermediate shaft, same line, has been sunk 24 ft., and secured with timber 38 ft., sinking through runs of slate and sandstone; present depth, 45 ft."

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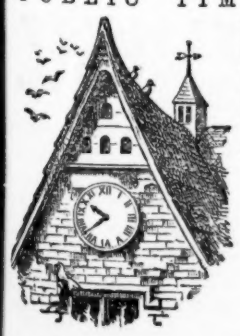

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BY APPOINTMENT TO HER MOST GRACIOUS MAJESTY THE QUEEN.

FEARFUL

BOILER EXPLOSIONS AVOIDED BY USING PAYNE'S ANTI-CORROSIVE FLUID.

It is highly recommended by Engineers to Proprietors of Steam Boilers (Marine or Stationary) for PREVENTION and REMOVAL of INCRUSTATION. The price is 6s. per gallon. One gill per horse power per week will remove any incrustation from old boilers, and keep new perfect.

[CERTIFICATE.]

"19, *Staunton-terrace, Blue Anchor-road, S.E., March* 12, 1869.

"DEAR SIR,—I have minutely examined your Anti-Corrosive Preparation, and can state with confidence that in no way is it injurious to iron or brass. It is inodorous and perfectly harmless, even when swallowed. T. R. L. HOOPER, M.R.C.S.L.

"Mr. Payne."

ORDERS ADDRESSED TO

PAYNE AND CO.,

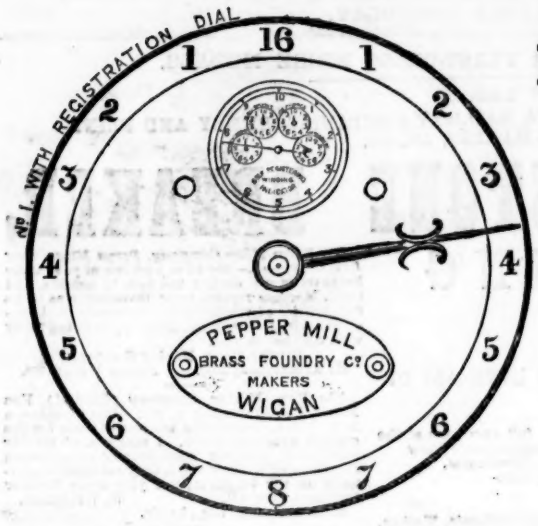
33, CHERRY GARDEN STREET, BERMONDSEY, LONDON, S.E.

PEPPER MILL BRASS FOUNDRY COMPANY,

DARLINGTON STREET, WIGAN,

COLLIERY FURNISHERS,

BRASS FOUNDERS, COPPERSMITHS, & GAS METER MANUFACTURERS,

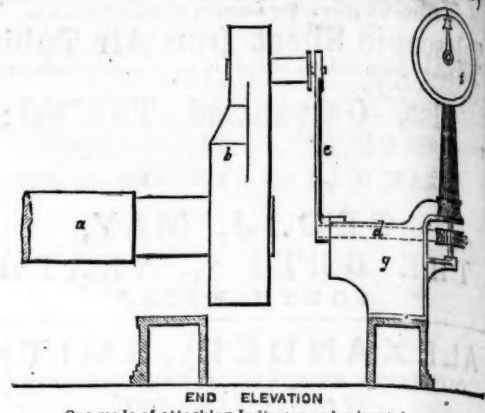


The PEPPER MILL BRASS FOUNDRY COMPANY beg respectfully to invite attention to their IMPROVED SELF-REGISTERING COLLIERY WINDING INDICATOR, which, in addition to its ordinary use of indicating the position of the load in the shaft, registers the number of windings, thus enabling the manager at a glance, and at any moment, to check the return of the banksman or tallyman, by reading off from the dial the number of windings for any stated time.

This Indicator is especially adapted for Water Winding or Pumping. Its indications cannot possibly be tampered with, and unerringly show the number of windings or strokes for any stated period, so that it will at once be seen whether or not the person in charge has been fully discharging his duty.

These Winding Indicators are supplied either with or without the Self-registration Dial.

The Pepper Mill Brass Foundry Company will be glad to furnish, on application, sets of drawings illustrative of the simplest and cheapest mode of attaching their indicators to engines of various constructions, either vertical or horizontal.



END ELEVATION

One mode of attaching Indicator to horizontal engine.

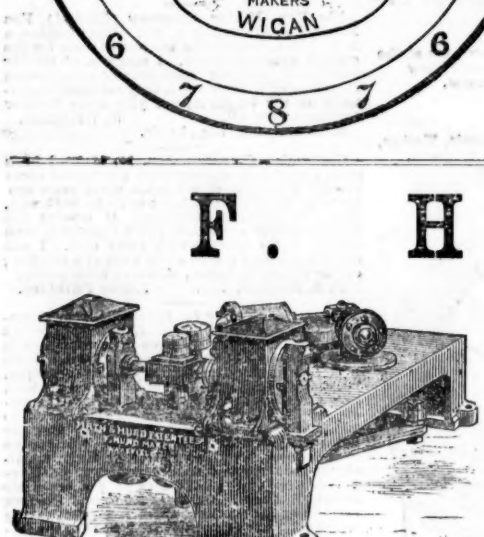
F. HURD, ENGINEER,

MILLWRIGHT, MACHINIST,

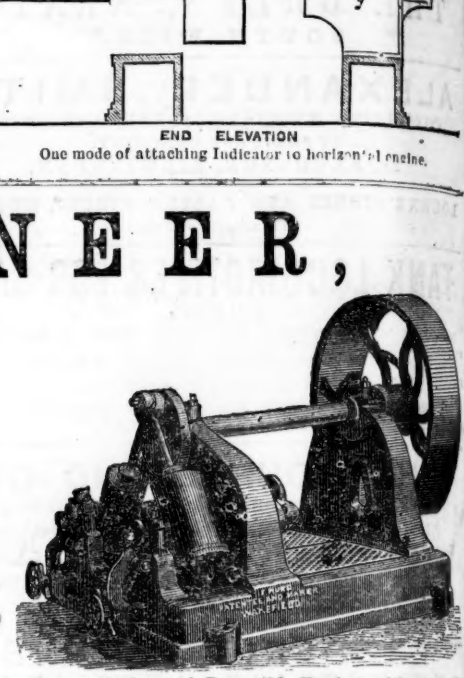
BRASS AND IRON FOUNDER,

ALBION FOUNDRY,

WAKEFIELD.



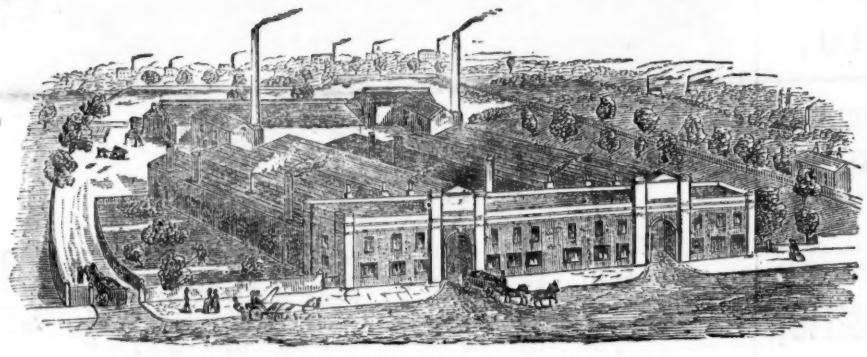
Patent Air-Compressing Engine.



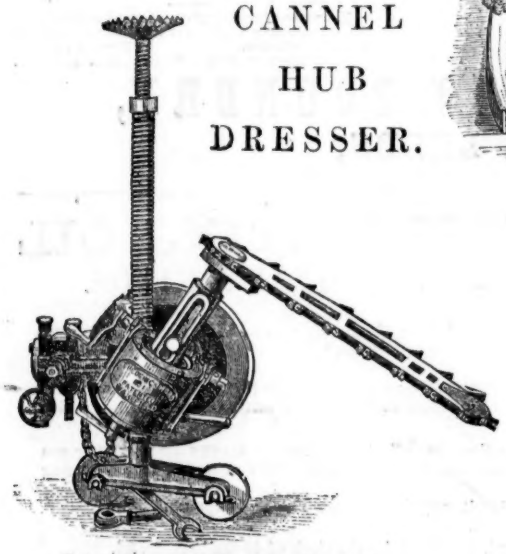
Patent High-speed Reversible Engine, without the aid of Tappets, Cams, or Eccentrics. Cylinders either fixed or oscillating.

MANUFACTURER
Of PATENT MINING and EXCAVATING MACHINERY.

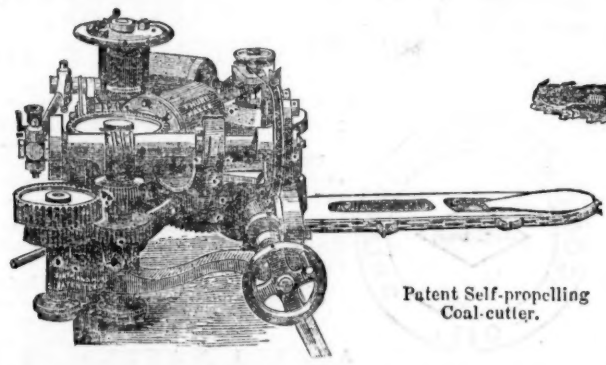
FIRTH'S PATENT CANNEL HUB DRESSER.



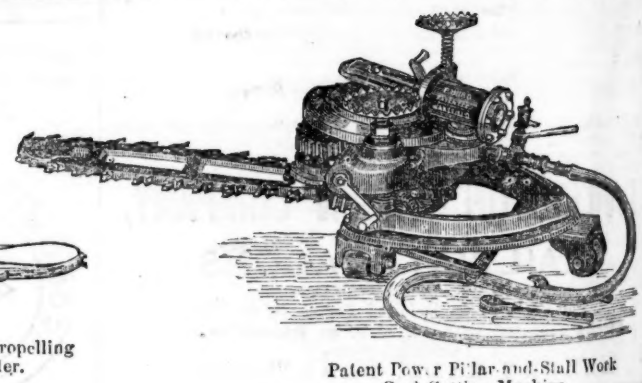
HYDRAULIC and AIR-COMPRESSING MACHINERY. Heavy, Light, and Ornamental CASTINGS, and Patent WORSTED MACHINERY.



Patent Power, or Hand Straight Work Coal-Cutting Machine.



Patent Self-propelling Coal-cutter.

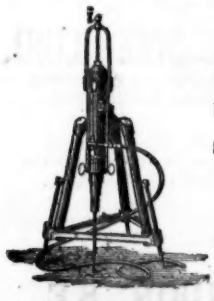


Patent Power Pillar-and-Stall Work Coal-Cutting Machine.

Also, FIRTH'S PATENT ECONOMIC PERMANENT RAILWAY, without the aid of Pins, Bolts, or Wedges, that can be laid by an ordinary labourer with rapidity.

GENERAL CONTRACTOR; and Estimates given for Air-Compressing Machinery and Coal-Cutting Machinery on application.

THE BURLEIGH ROCK DRILL.



THE BEST AND ONLY PRACTICAL DRILL.

IT DOES NOT GET OUT OF ORDER.

SPECIALLY ADAPTED FOR SINKING AND MINING PURPOSES.

PROGRESSES through Aberdeen granite at the incredible rate of 10" per minute.

SAVES £5 a day as compared with hand labour, independent of the enormous saving effected in the general expenses, such as PUMPING, VENTILATION, INTEREST OF CAPITAL, &c., from the fact of the "put out" being increased four-fold.

DRILL POINTS.—The saving in steel alone is considerable. One drill will go through 20 feet of Aberdeen granite without sharpening.

Orders received and executed solely by—

Messrs. CHAS. BALL & CO.,

21, NEW BRIDGE STREET, E.C., LONDON,

ENGINEERS, CONTRACTORS, AND GENERAL MERCHANTS.

PATENT

SELF-LUBRICATIVE STEAM & HYDRAULIC ENGINE PACKING.

This Packing is invaluable to all Users of Steam-Power; it supersedes anything of the kind ever invented; it is now in use in all the Chief Railways and First Firms in this Country and Abroad, and is

THE ONLY PACKING THAT WORKS WITHOUT OIL OR GREASE,

Does not char, is pliable, keeps the rods

COOL, BRIGHT, AND CLEAN,

And lasts longer than any other, thereby

SAVING FULLY 200 PER CENT.

To the User, in oil, labour, and material.

Can be had only from the Agents throughout the country, appointed by

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[FOR THE LUBRICATIVE PACKING COMPANY],

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